ANALOGS OF YUMA TER IN THE SOUTH CENTRAL ASIAN [

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AUGUST 1962 T.R. 3-630 rept. 2

PREPARED BY THE

GEOLOGY BRANCH-SOILS DIVISION

U.S. ARMY ENGINEER WATERWAYS EXPERIMENT
CORPS OF ENGINEERS

VICKSBURG, MISSISSIPPI

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ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT

SECTION I: BASIC TERRAIN FACTOR AND ANALOG MAPS 30523

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Scope of Study

This folio is a revision of the third in a series comparing the terrain of the U. S. Army Test Station at Yuma, Arizona, with other world desert areas. The area being compared with the Yuma Test Station in this folio is the South Central Asian Desert. Included within this area are Iran, Pakistan, western Afghanistan, and northwestern India. The location and limits of the area and geographic subdivisions are shown in fig. 1 and plate 15. Desert boundaries were determined from homoclimatic maps compiled by Dr. Paveril Meigs (Review of Research on Arid Zone Hydrology, published by UNESCO, 1952). However modifications were made on the basis of geomorphic, soil, and vegetation data collected in the present study. Meigs' classification is oriented toward agricultural potentialities, with temperature and rainfall being the most important factors considered.

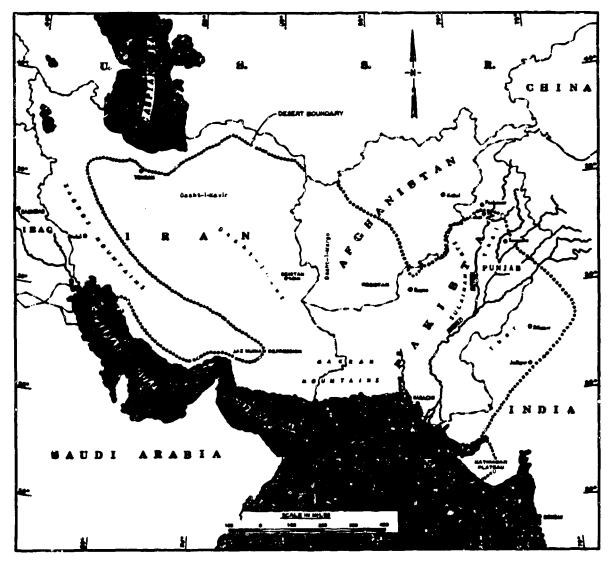


Fig. 1. South Central Asian Desert

The folio consists of a series of plates, each containing a map of the Yuma Test Station in the upper right-hand corner to enable easy comparison. Detailed explanations of the mapping procedures used in the preparation of the plates are found in the text entitled Handbook, A Technique for Preparing Desert Terrain Analogs, published by the Waterways Experiment Station in May 1959 (Technical Report No. 3-506).

Analogy with Yuma

The method of analog development depends on comparison of geometry factors (plan-profile, slope occurrence, characteristic slope, and characteristic relief), ground factors (soil type, soil consistency, and surface sock), and vegetation of the South Central Asian Desert with the same terrain types found at Yuma.

The terrain of the South Central Asian Desert was generally found to be moderately analogous to that found at the Yuma Test Station. Approximately 55 percent of the area is moderately analogous, 35 percent highly analogous, 7 percent slightly analogous, and 3 percent inappreciably analogous. None of the area was considered as nonanalogous.

Most of the areas mapped as highly analogous in South Central Asia were mountainous. Among these were the Makran Mountains in southern Iran, portions of the Zagros Mountains in western Iran, the Sulaiman Mountains of Pakistan, and the basin ranges in the interior of Iran. Other highly analogous areas include nonirrigated portions of the Indus floodplains and certain coastal plains of southern Iran.

Desert plains and sand dune areas are the main physiographic types mapped as moderately analogous. The coastal plains bordering Sulaiman and Makran Mountains on the south, irrigated portions of the Indus floodplain, and the large alluvial tract lying between the Indus and the Sulaiman Mountains were also mapped as moderately analogous.

Slightly analogous areas include vegetated dunes in the Registan and bordering the Jaz Murian Depression, the large desert plains east of Kohat and in the vicinity of Jodhpur, and the dune tract southwest of Bikaner.

The only area mapped as inappreciably analogous was the Kathiawar Plateau in southern Pakistan.

Although physiographic types and associated landforms are not used in determining the degree of analogy, the low degree of analogy between similar physiographic types is interesting. Some areas that are physiographically or landformwise similar to Yuma are mapped as slightly analogous. This is true of some of the desert plains in the area which are less dissected and have different soil and vegetative types than their Yuma counterparts. Other such areas include vegetated sand dune areas having different geometry and vegetation factor types and portions of the Indus floodplain where soil and vegetation types differ from their Yuma counterparts. Worthy of mention are areas in the South Central Asian Desert which are physiographically or landformwise dissimilar to Yuma, yet mapped as highly or moderately analogous. Highly analogous areas in this category are the Seistan Basin in eastern Iran, certain southern coastal plains, massive mountain ranges in northern Iran and southern Afghanistan, and parallel-ridge mountains in southern Pakistan. Moderately analogous areas dissimilar to Yuma are the great salt playas in the interior basin of Iran, coastal marsh areas, the Jaz Murian Depression, and longitudinal dune areas in the Thar Desert.

Sources of Information

Written physiographic and landform descriptions of the South Central Asian Desert are scarce. In many areas only brief travelers' accounts are

available to supplement the small-scale map coverage. These accounts were helpful in delineating boundaries between major physiographic types and in describing their associated landforms. Data were more abundant in some areas than in others. The Seistan Basin, Jaz Murian Depression, southern part of the Dasht-i-Lut, Punjab, the Sulaiman Mountains in the vicinity of Quetta, the Makran Mountains, and coastalareas in southern Iran were regions in which good descriptive accounts were available. Some of the regions in which written data were scarce or lacking were large portions of the Thal, Thar, and Registan Deserts, the great interior basin of Iran, the mountains of northern Iran and southern Afghanistan, and the southern Sulaiman Mountains of Pakistan.

Large-scale map coverage was available on Iran in the vicinity of Dizful and Tehran and on Pakistan in the vicinity of Karachi, Quetta, Sargodha, and Peshawar. These were helpful locally in preparing the geometry and vegetation maps. Full coverage of the area was provided by several sets of small-scale maps. Coverage of the entire area at a scale of 1:1,000,000 was provided by USAF World Aeronautical Charts and Geographical Section, General Staff maps. These were used in the preparation of the physiography, landforms-surface conditions, and geometry-factor maps. Complete coverage of U.S. Department of Agriculture World Soil Maps by the Bureau of Plant Industry at a scale of 1:1,000,000, together with definitions and symbols, was useful in the determination of the soil, soil consistency, and often of the rock types. These maps were also of some limited use in determining the vegetative types. Data for the hypsometric maps of Yuma were taken from U.S. Strategic Maps at a scale of 1:500,000; for the South Central Asian Desert these data were obtained principally from Air Force Aeronautical Planning Charts at a scale of 1:5,000,000.

The principal sources of information for the Yuma Test Station were the following: A report, Terrain Study of the Yuma Test Station Area, Arizona, prepared for the U. S. Army Engineer Waterways Experiment Station by Purdue University in March 1955; Handbook of Yuma Environment, published by Office, Quartermaster General, in February 1953 (Report No. 200); and A Study of Desert Surface Conditions by Thomas Clements and others, published by Quartermaster Research and Development Command in April 1957 (Technical Report EP-53).

Authorization and Acknowledgments

This study is a part of Research and Development project No. 8S70-09-001, entitled "Military Evaluation of Geographic Areas," which has been assigned to the U.S. Army Engineer Waterways Experiment Station by the Office, Chief of Engineers, and is being performed for Office, Chief of Research and Development, Department of the Army. The project is directed by the Area Evaluation Section of the Soils Division, Waterways Experiment Station.

This folio is a revision of an earlier report (Analoge of Yuma Terrain in the South Central Asian Desert, dated March 1959), which was prepared without the assistance of any fieldwork. The survey of the available literature and actual mapping was done by Mr. William K. Dornbusch, Jr., Geology Branch, WES, under the immediate supervision of Dr. Charles R. Kolb, Chief

of the Geology Branch. Technical assistance was rendered by Mr. Harry K. Woods, Mr. Jerald D. Broughton, and Mr. P. R. Mabrey, all of the Geology Branch, and Mr. Warren E. Grabau, Chief, Area Evaluation Section. The project was under the general supervision of Mr. W. J. Turnbull and Mr. W. G. Shockley, Chief and Assistant Chief, respectively, Soils Division.

Directors of the Waterways Experiment Station during this study were Col. Edmund H. Lang, CE, and Col. Alex G. Sutton, Jr., CE. Technical Director was Mr. J. B. Tiffany.

ASSOCIATED REPORTS

Date	<u>Title</u>
Feb. 1958	Analogs of Yuma Terrain in the Northeast African Desert (revised June 1962)
Feb. 1958	Analogs of Yuma Terrain in the Northwest African Desert (under revision)
Mar. 1959	Analogs of Yuma Terrain in the South Central Asian Desert (revised June 1962)
Apr. 1959	Analogs of Yuma Terrain in the Mexican Desert
May 1960	Analogs of Yun Terrain in the Middle Eastern Desert

- LIST OF PLATES -

SECTION I: BASIC TERRAIN FACTOR AND ANALOG MAPS

Plate 1. Characteristic Plan-Profile

Plate 2. Occurrence of Slopes Greater than 50 Percent

Plate 3. Characteristic Slope

Plate 4. Characteristic Relief

Plate 5. Generalized Landscape

Plate 6. Soil Type

Plate 7. Soil Consistency

Plate 8. Surface Rock

Plats 9. Vegetation

Plate 10. Geometry Analogs

Plate 11. Ground Analogs

Plate 12. Vegetation Analogs

Plats 13. Terrain-Type Analogs

SECTION II: SUPPLEMENTAL MAPS AND TABULATIONS

Plate 14. Hypsometry

Plate 15. Physiography

Plate 16. Physiography: Descriptions and Photographs

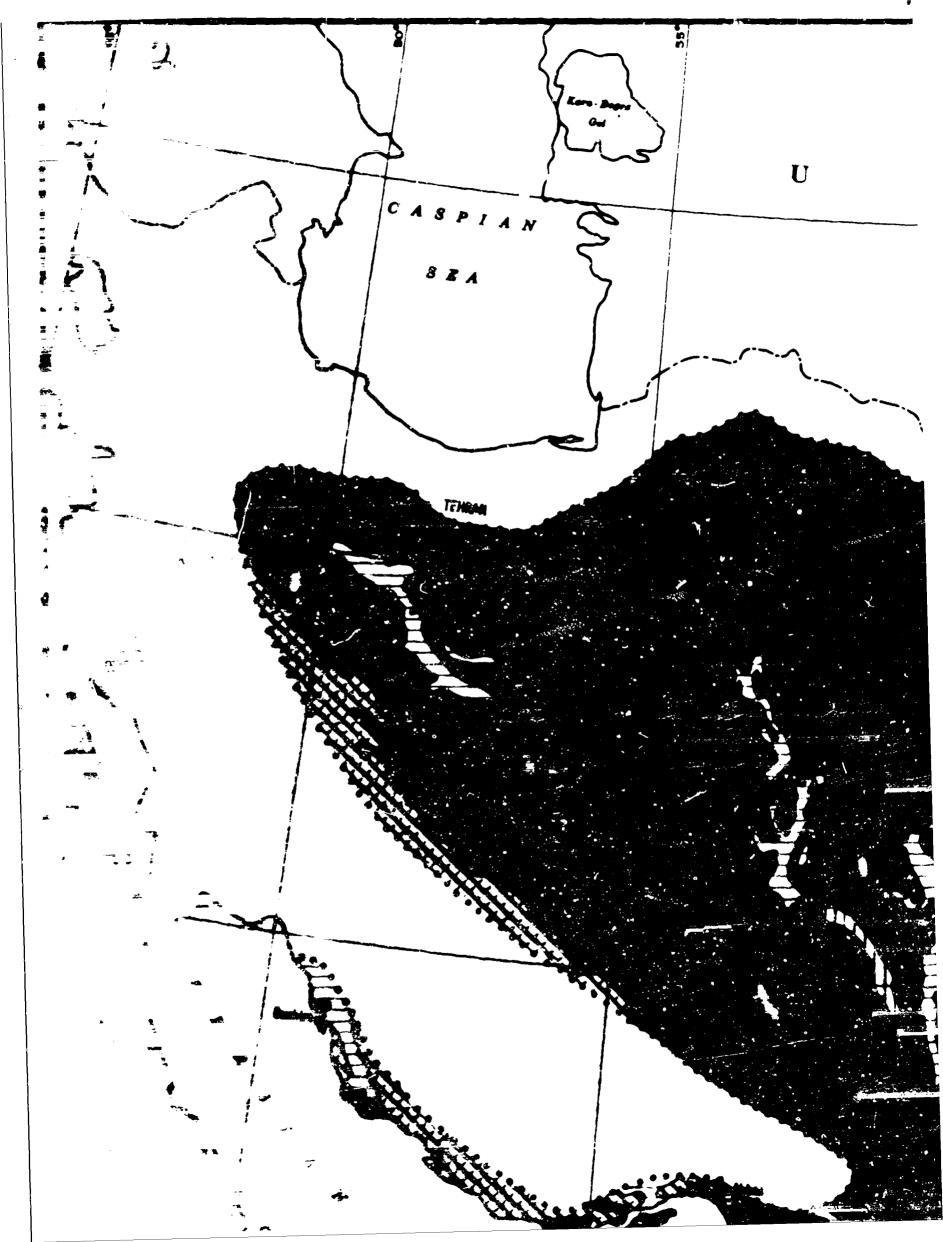
Plate 17. Selected Landforms and Surface Conditions

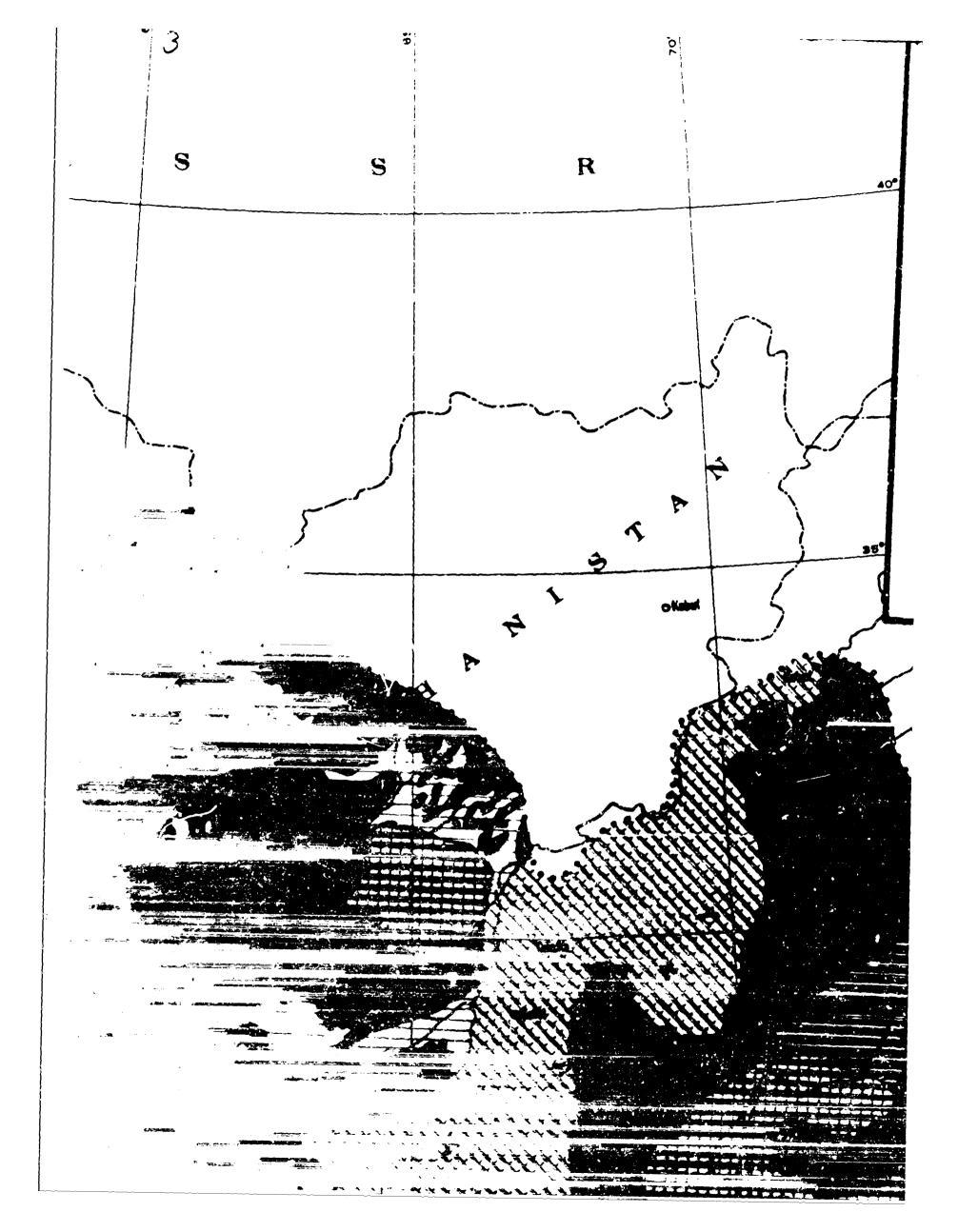
Plate 18. Selected Landforms and Surface Conditions: Descriptions and Photographs

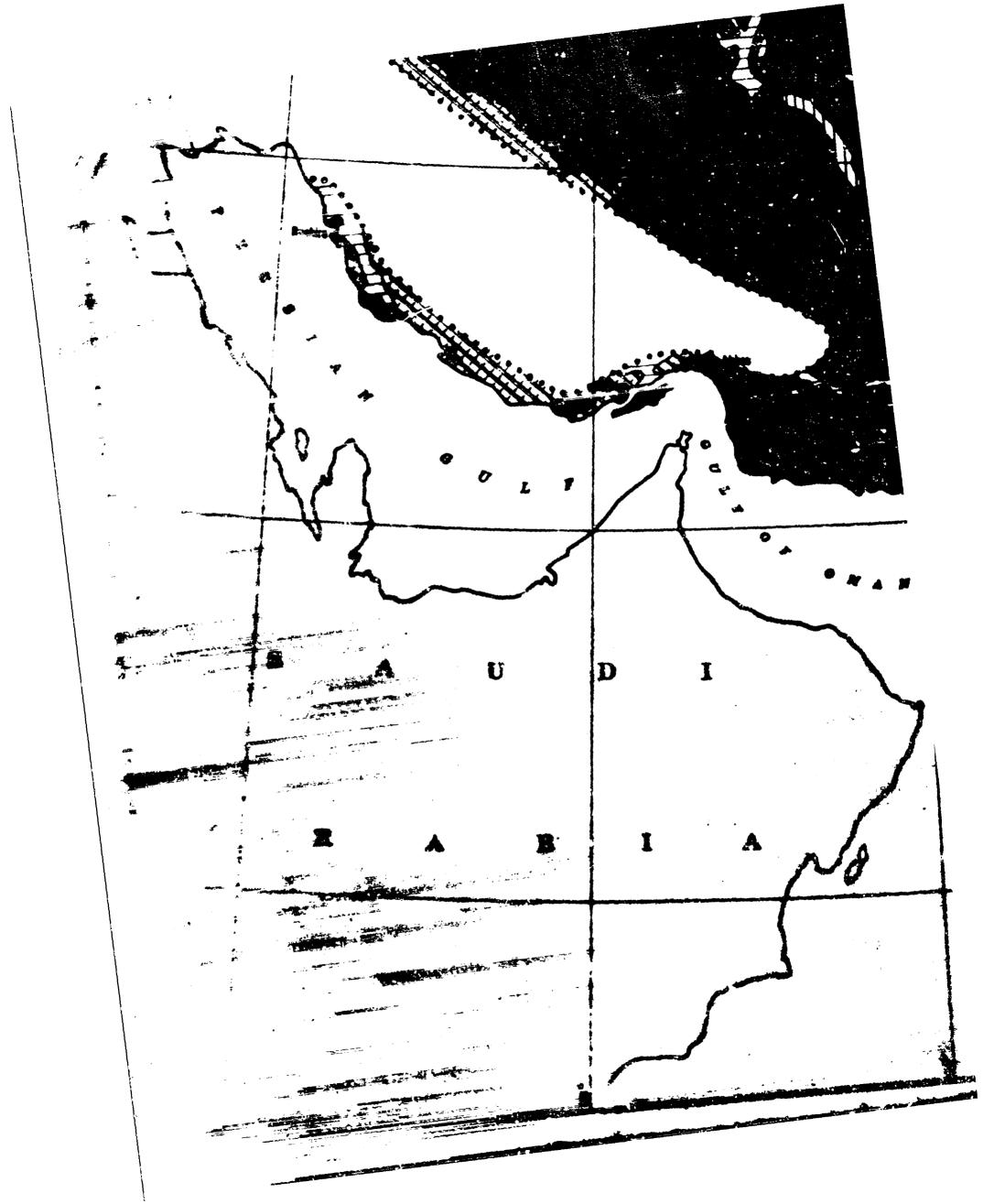
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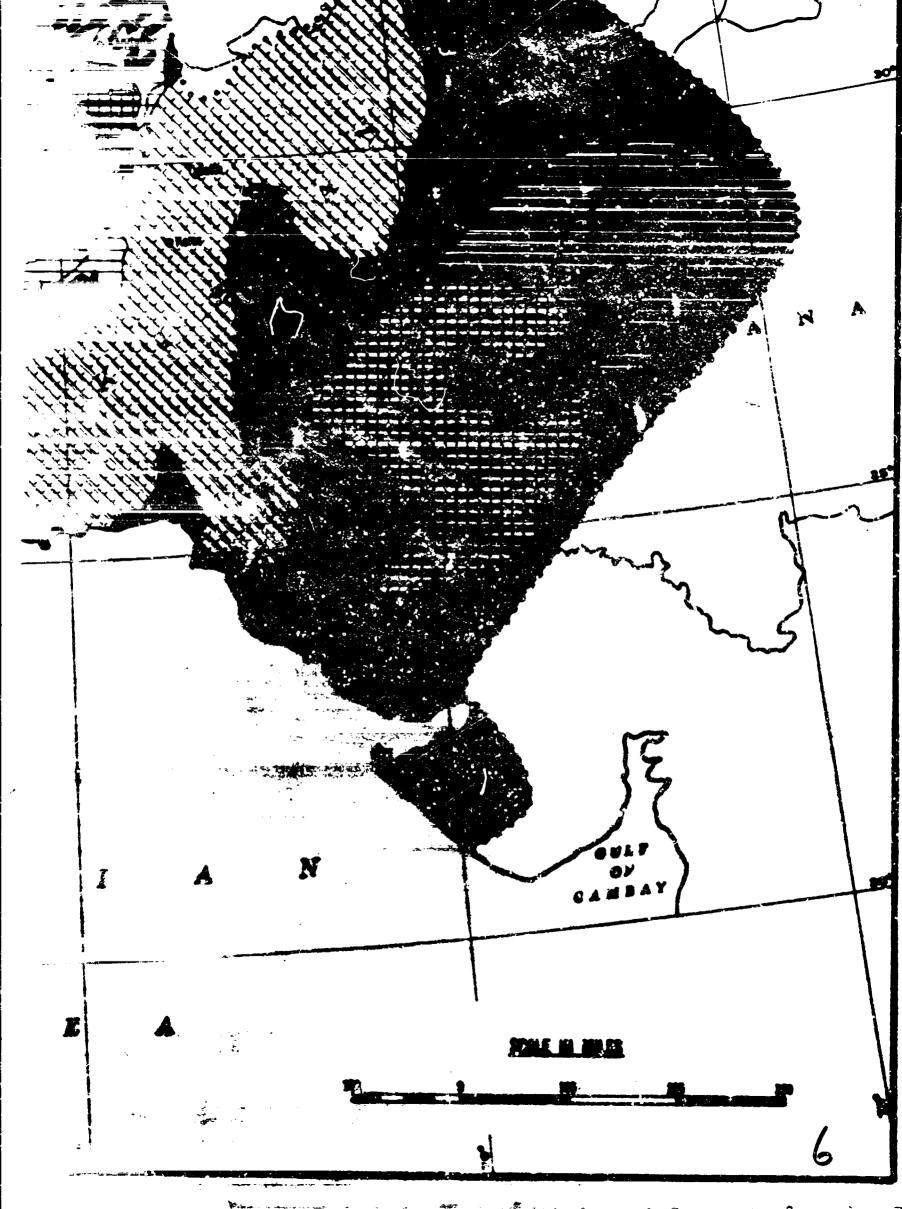
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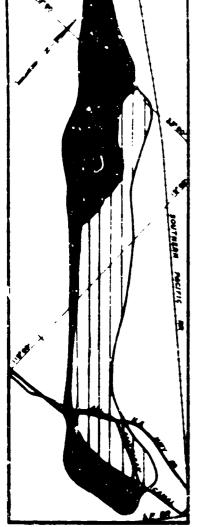












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YUMA TEST STATION (GROSS PLAN-PROFILE: SLA)

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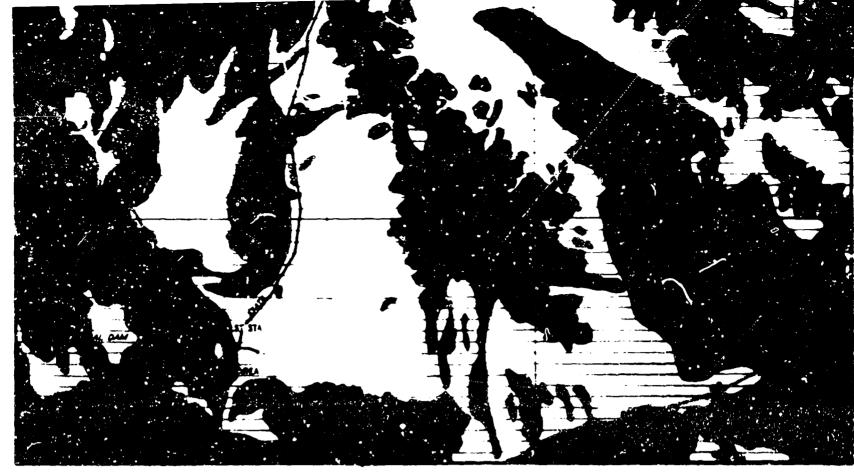
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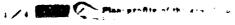


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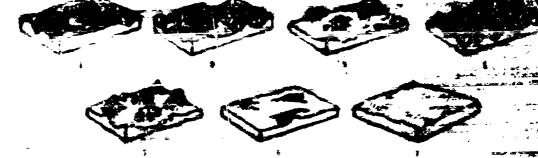
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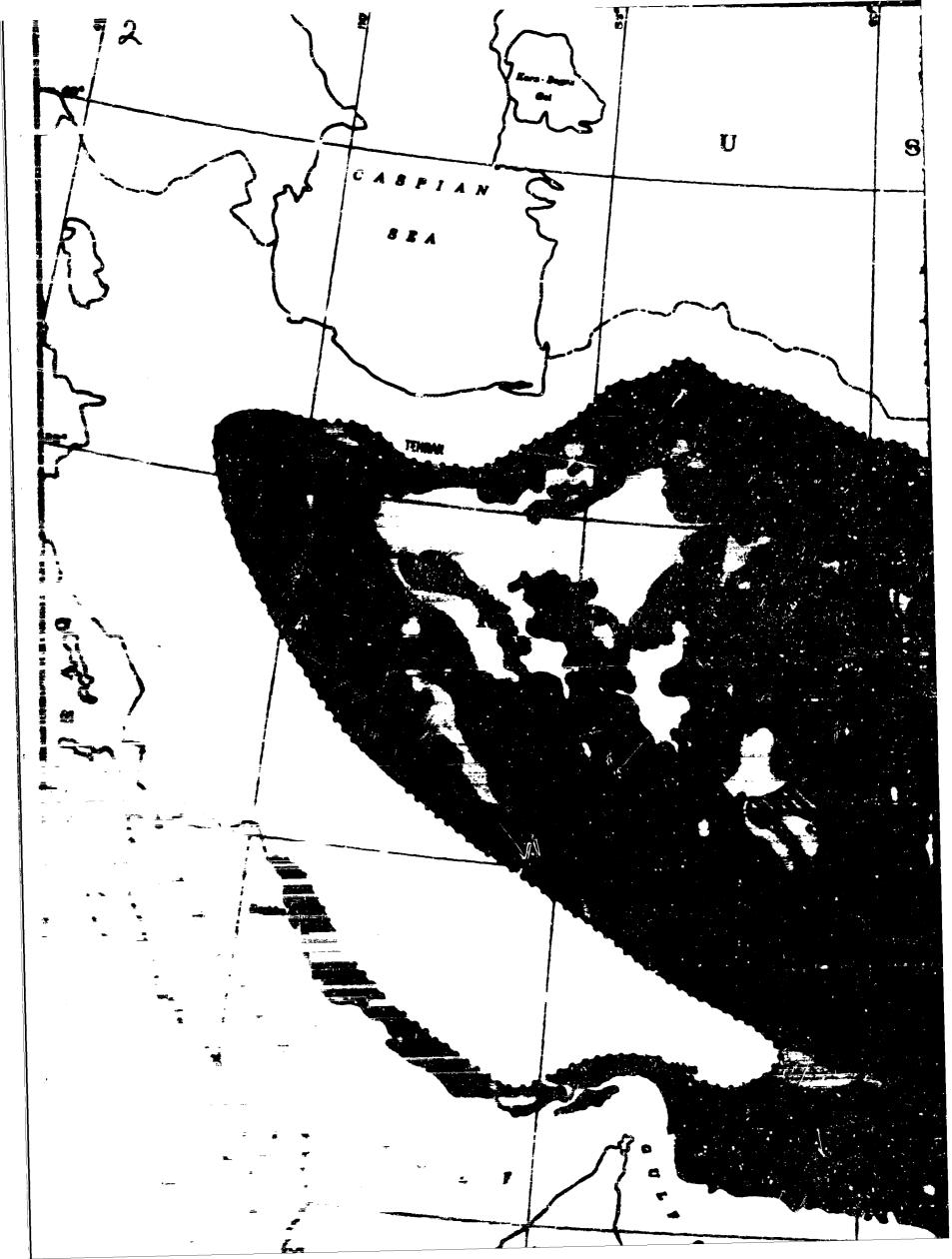


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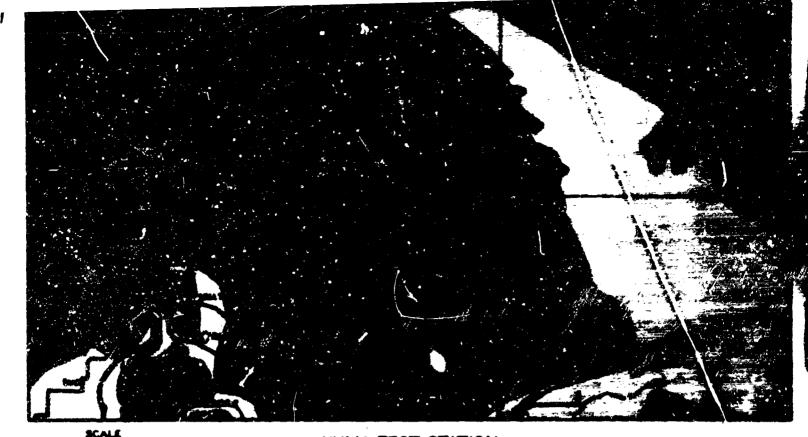
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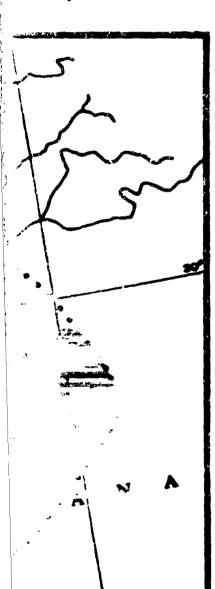






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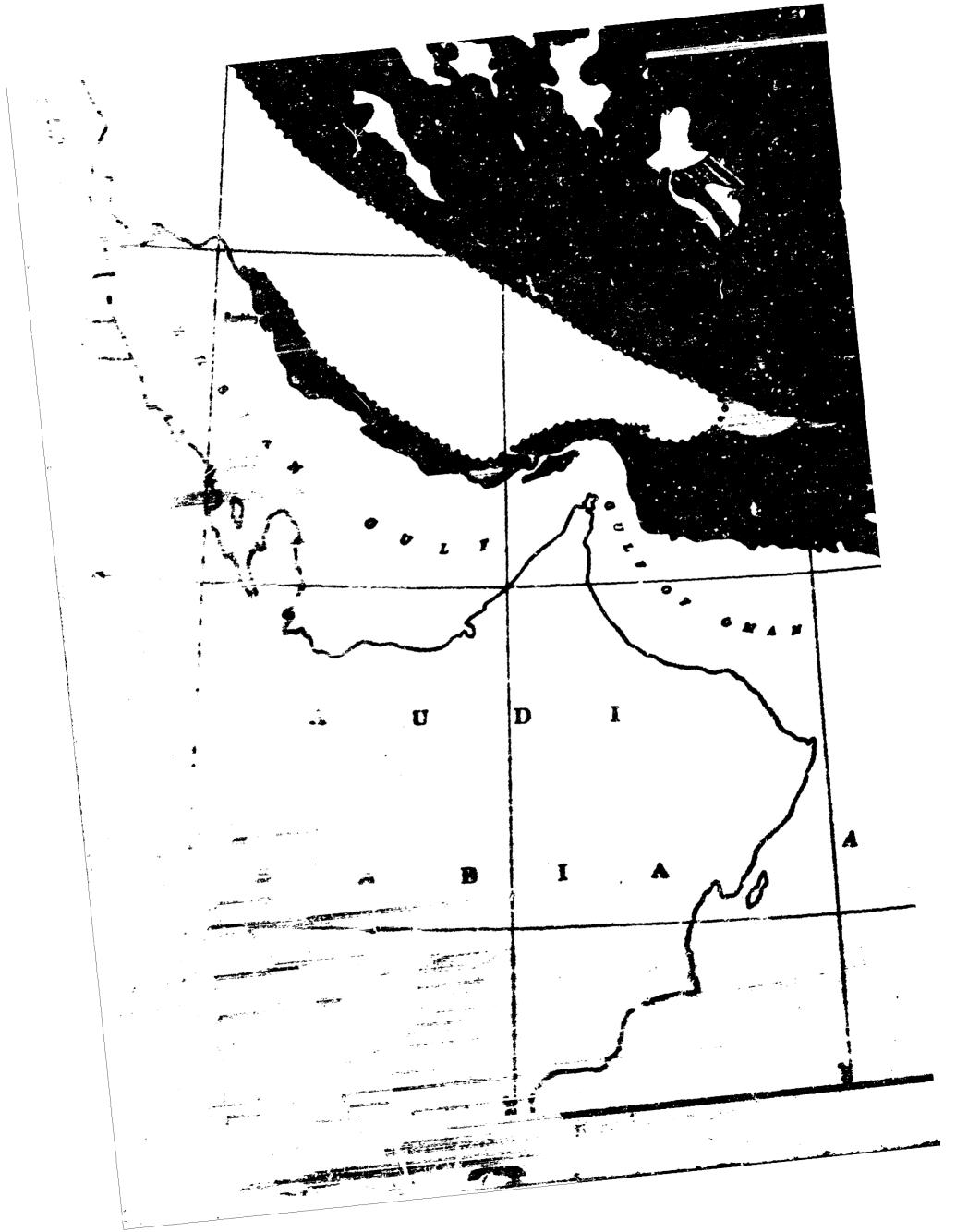
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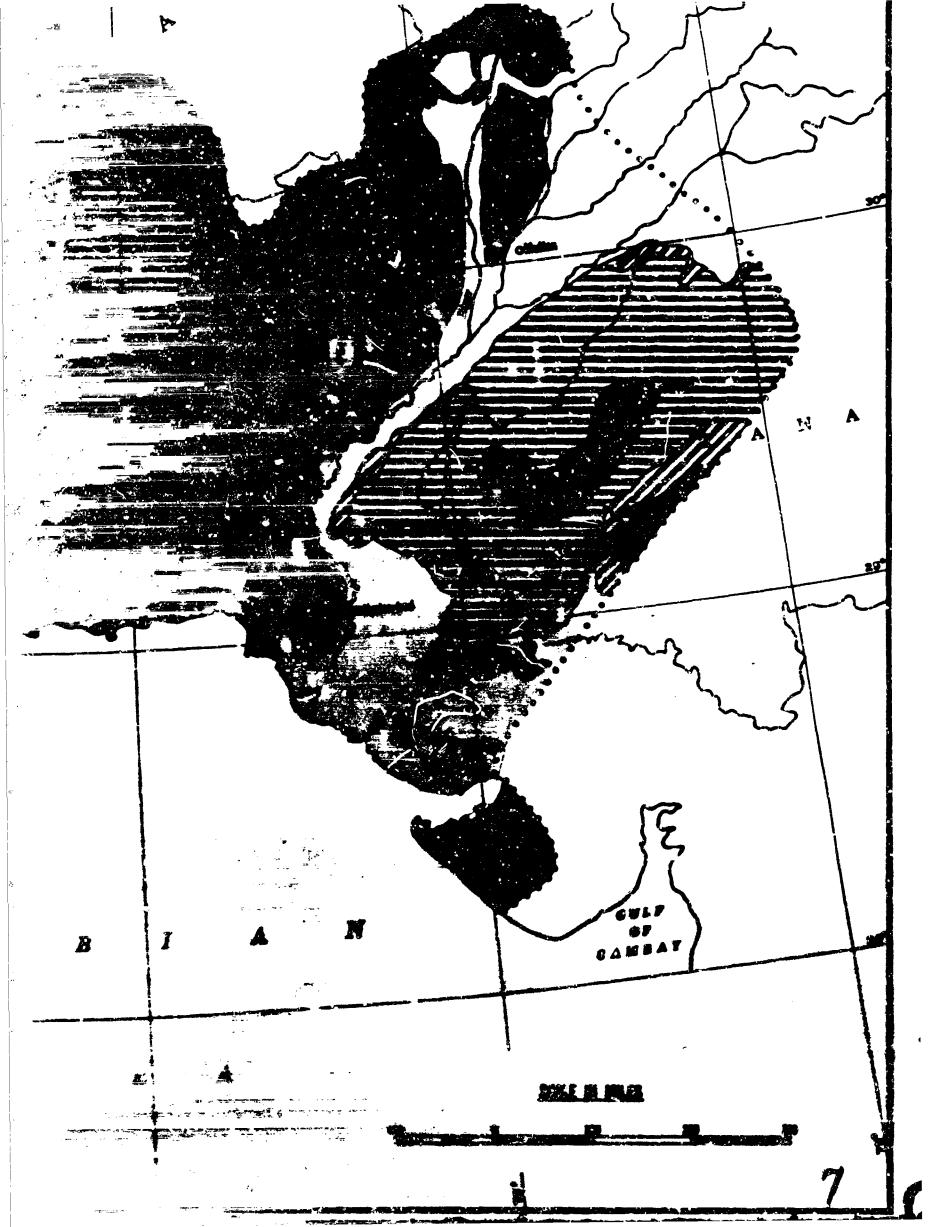
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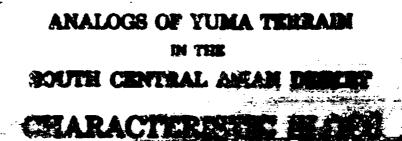
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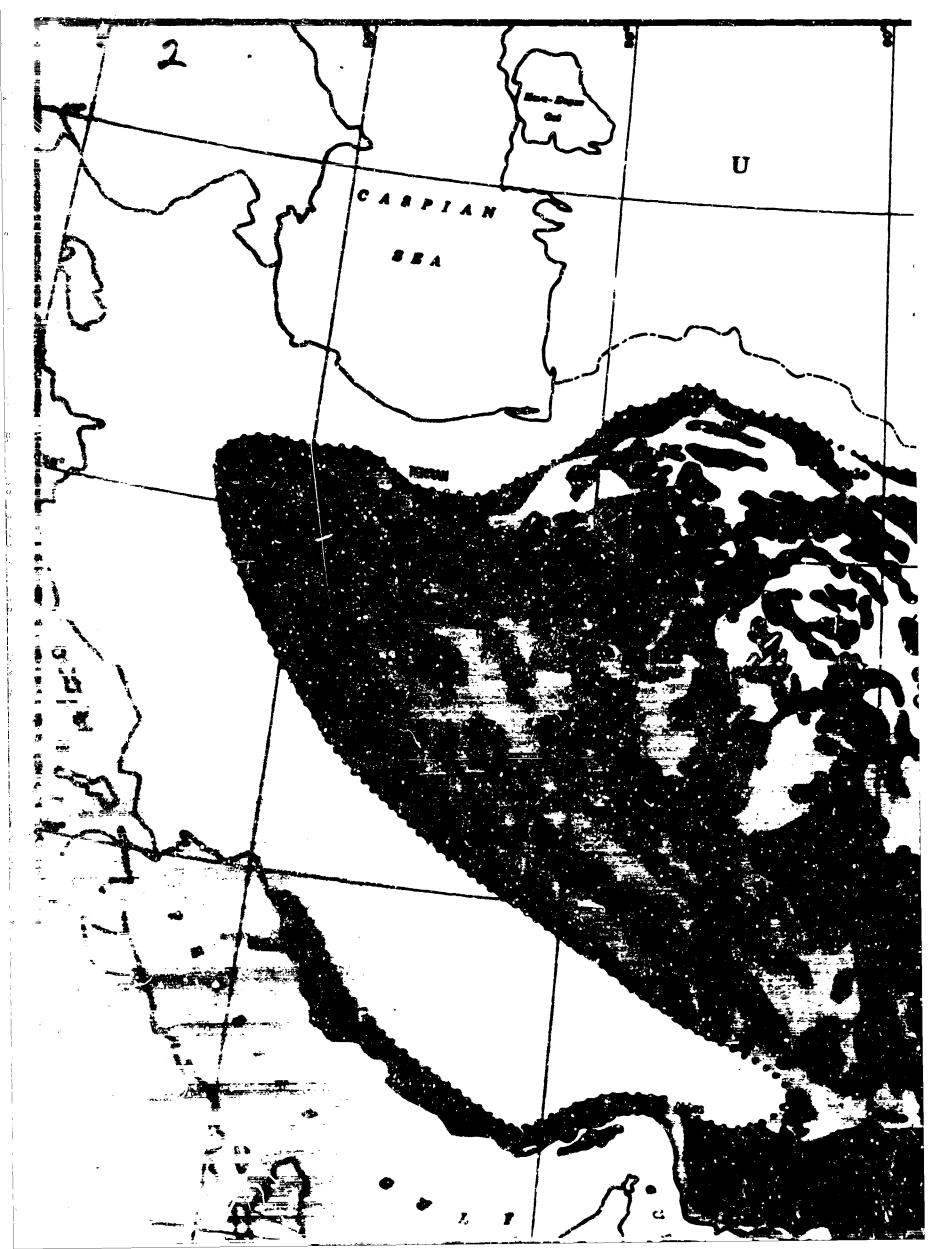






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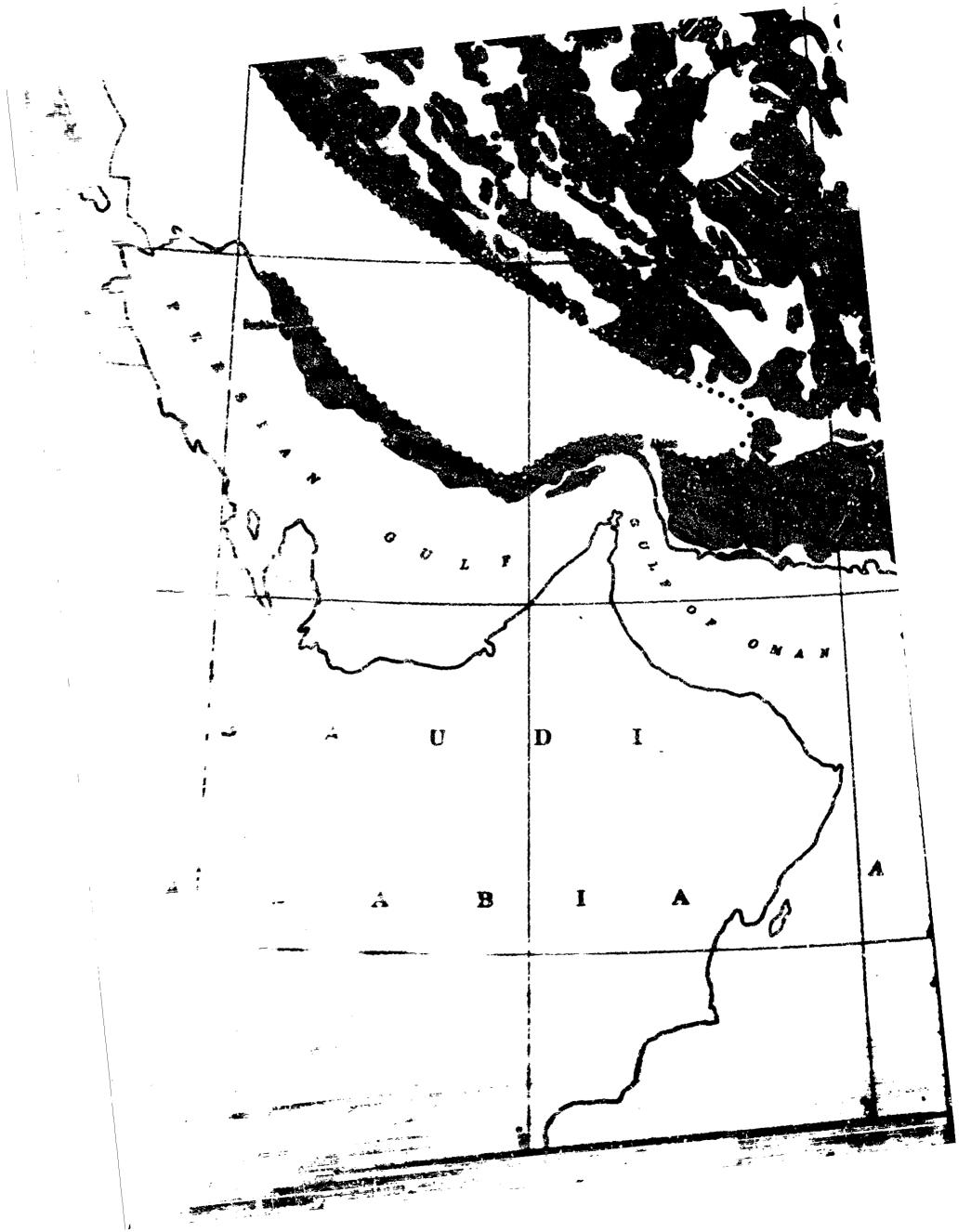


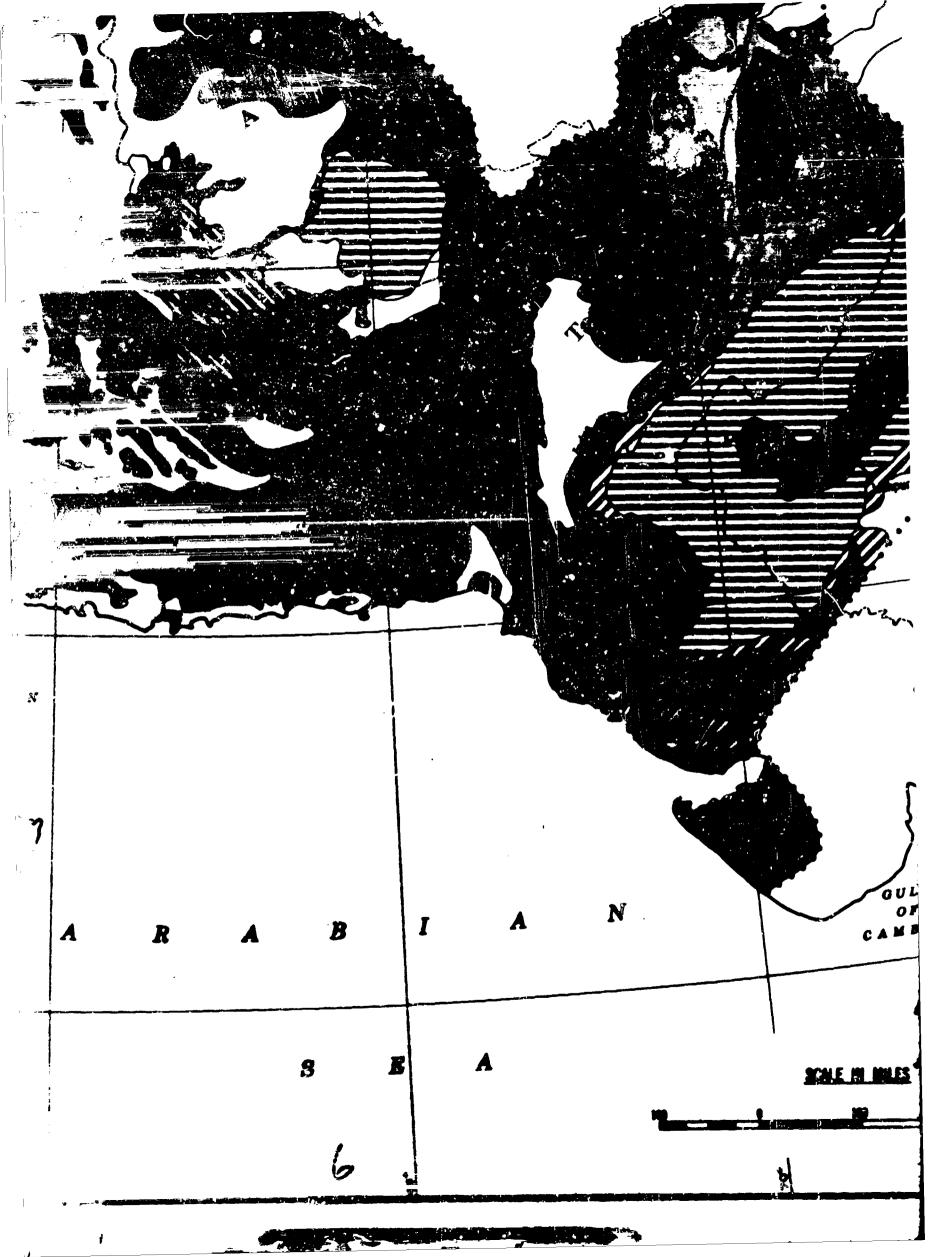
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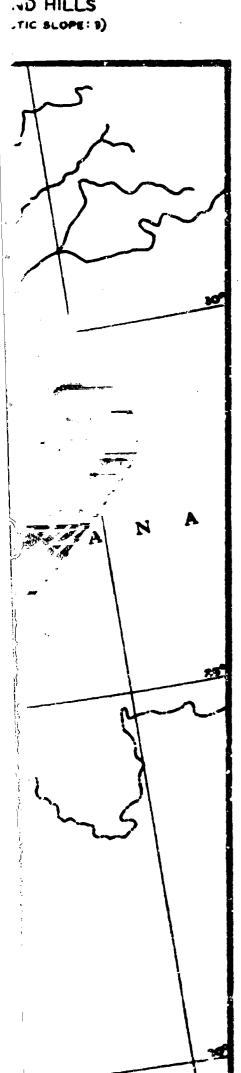




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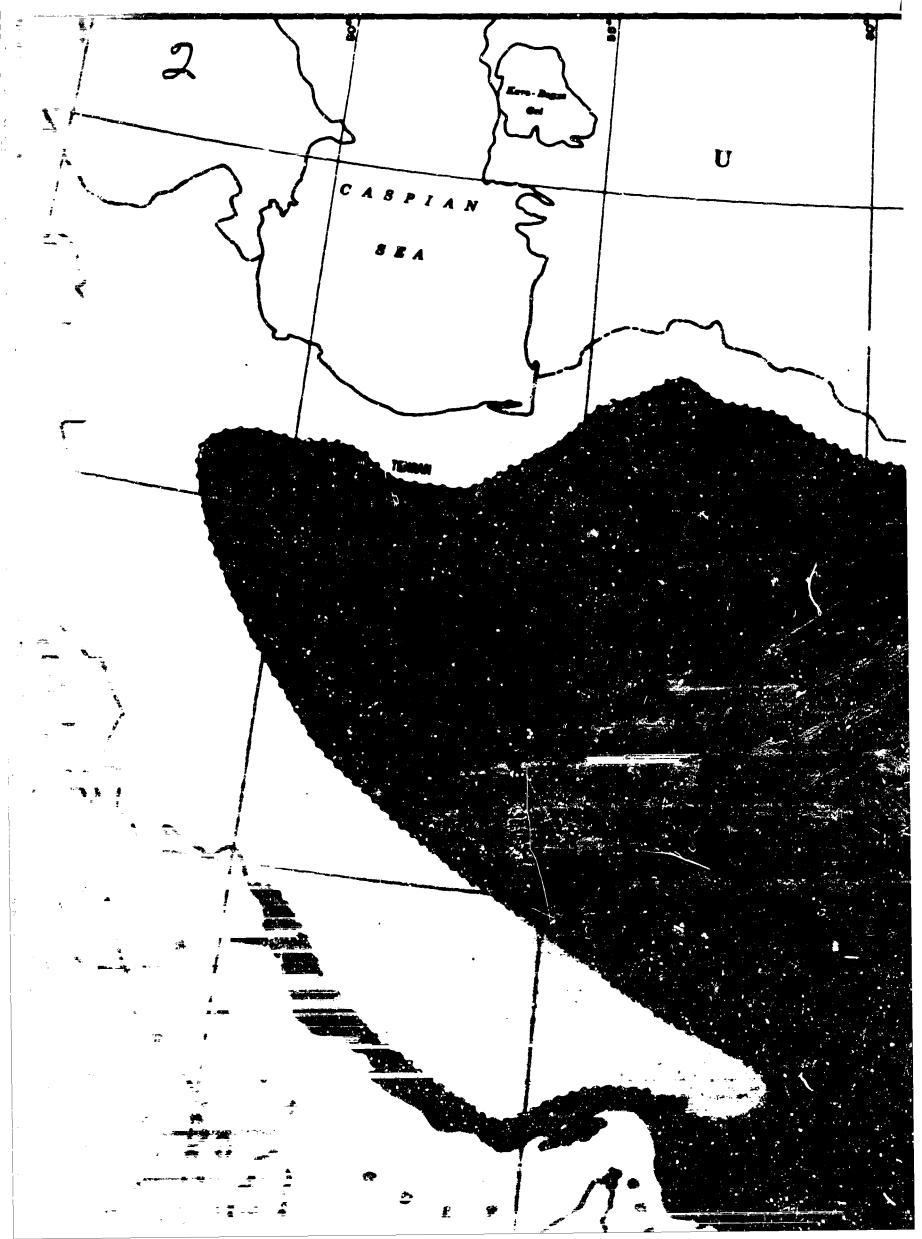


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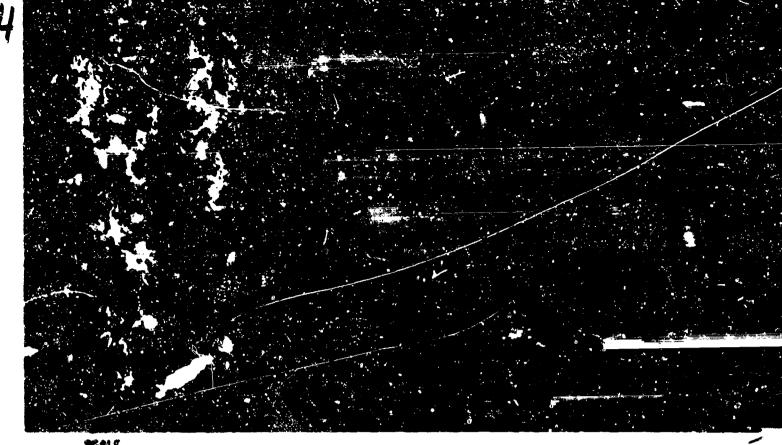
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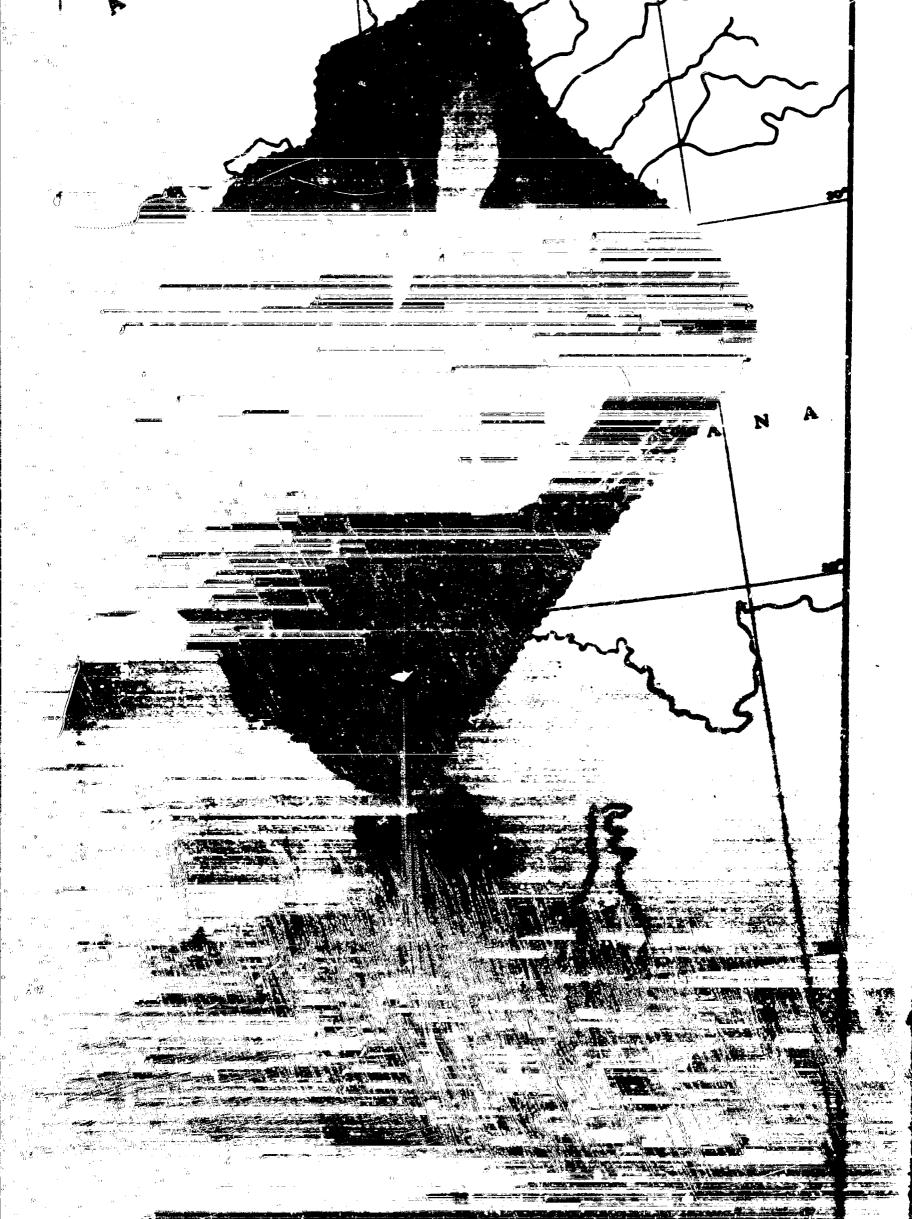


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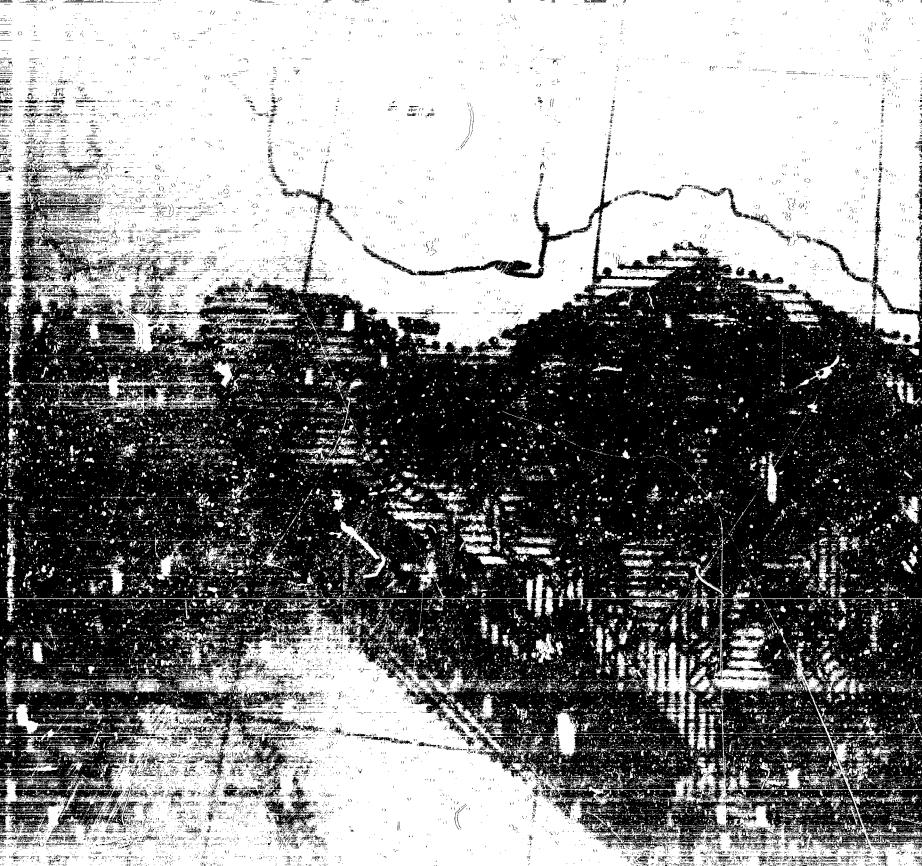
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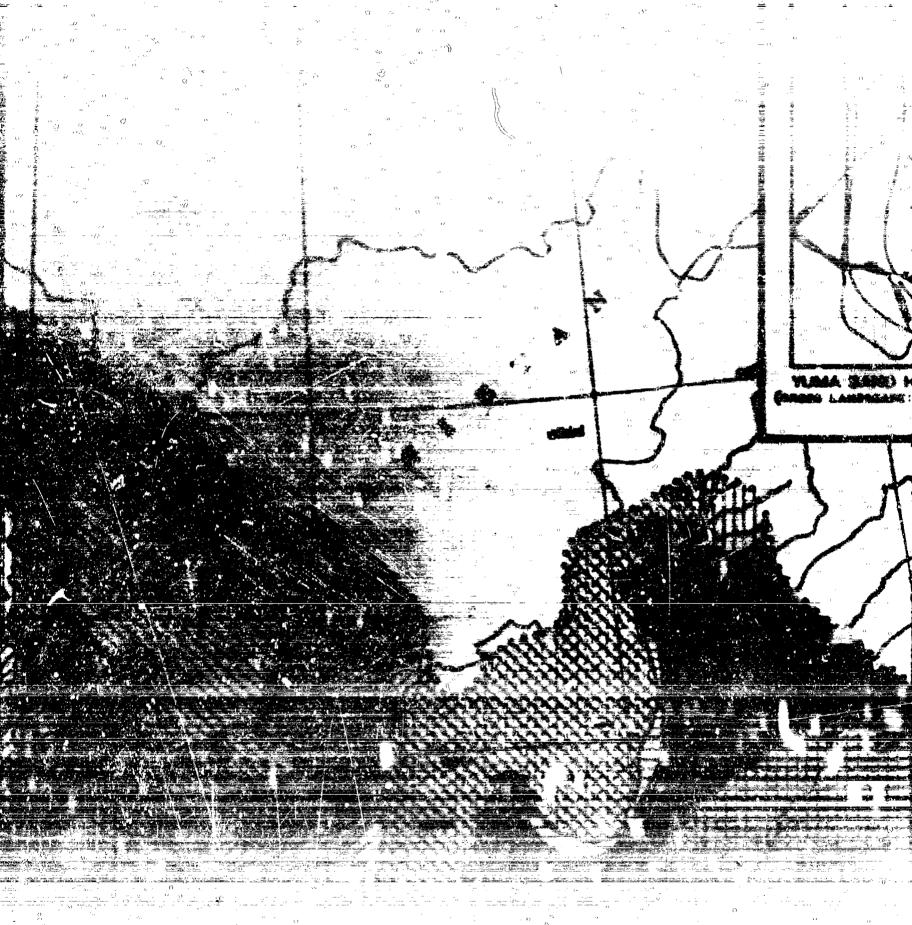
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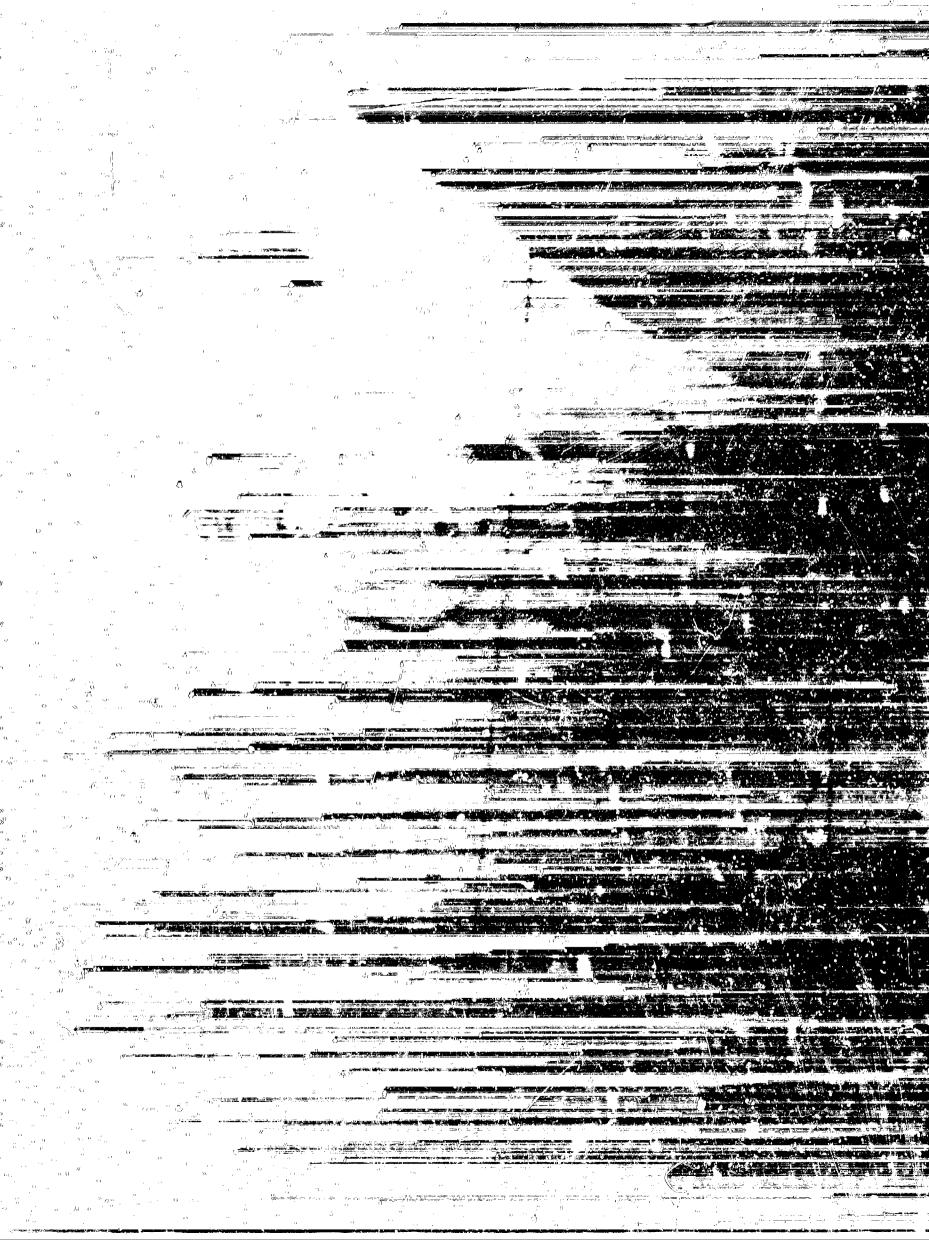
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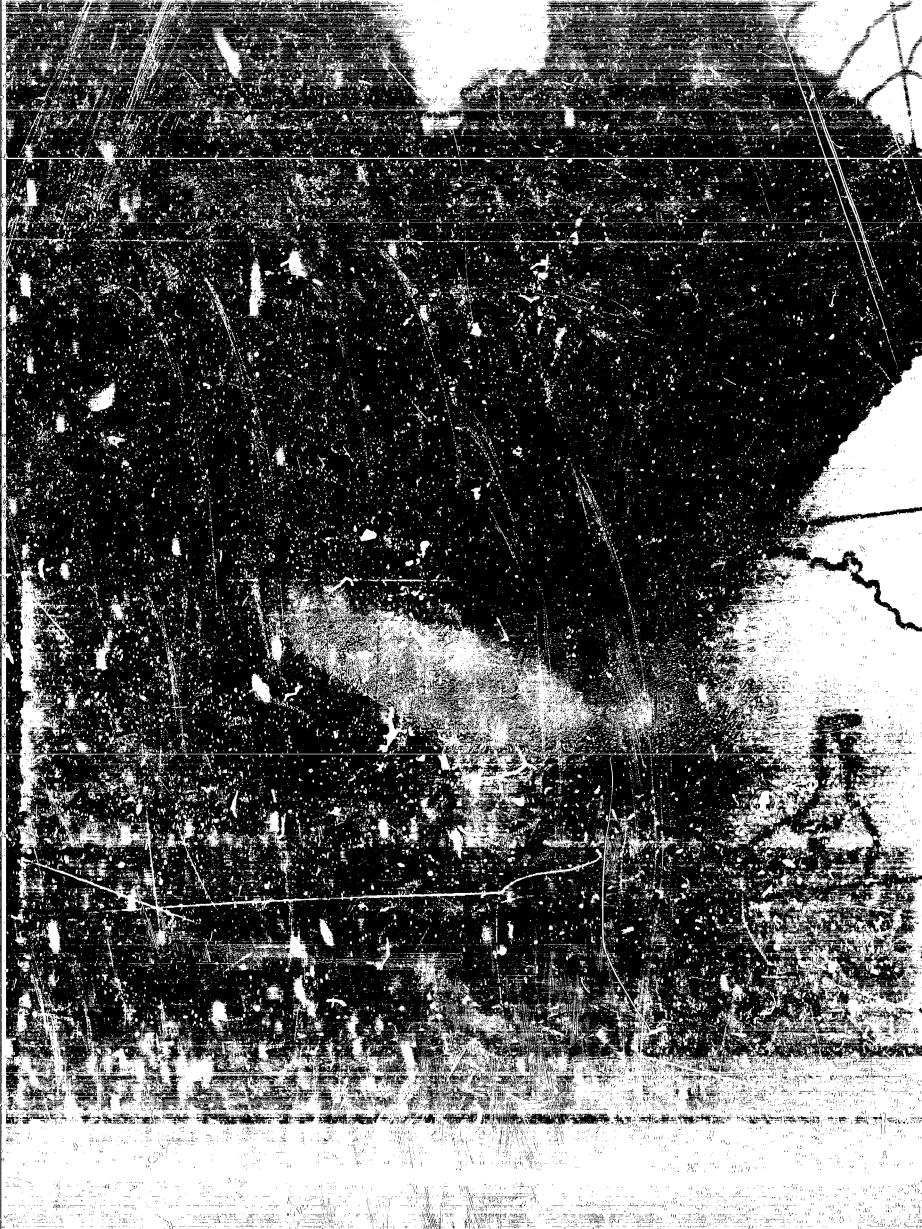
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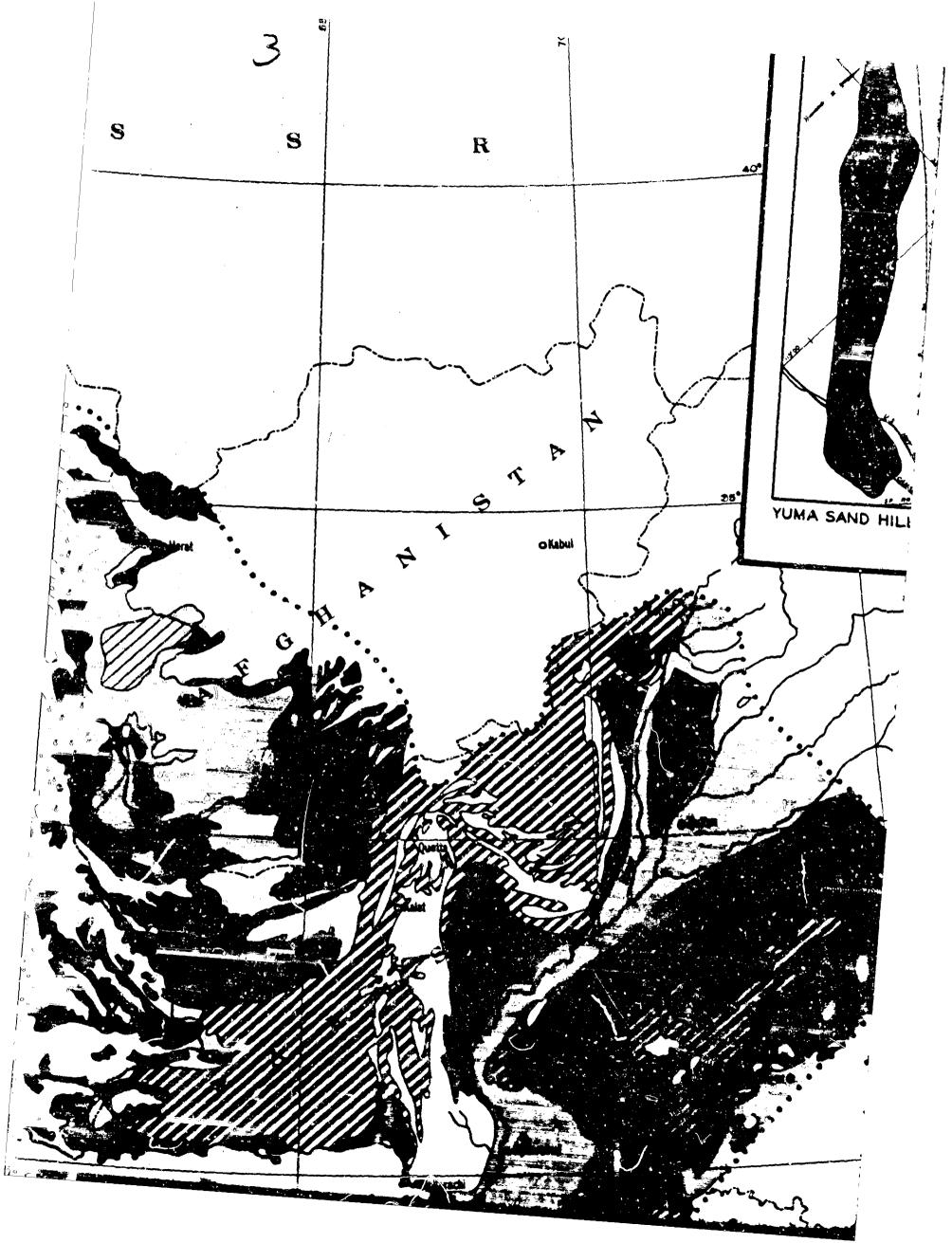


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ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
SOIL CONSISTENCY

PLATE 7

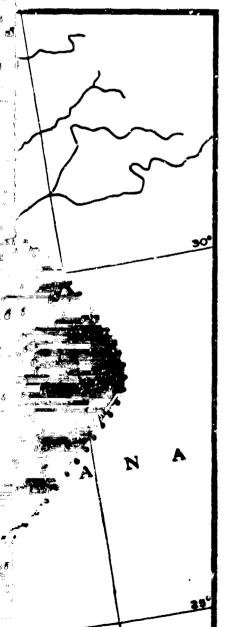






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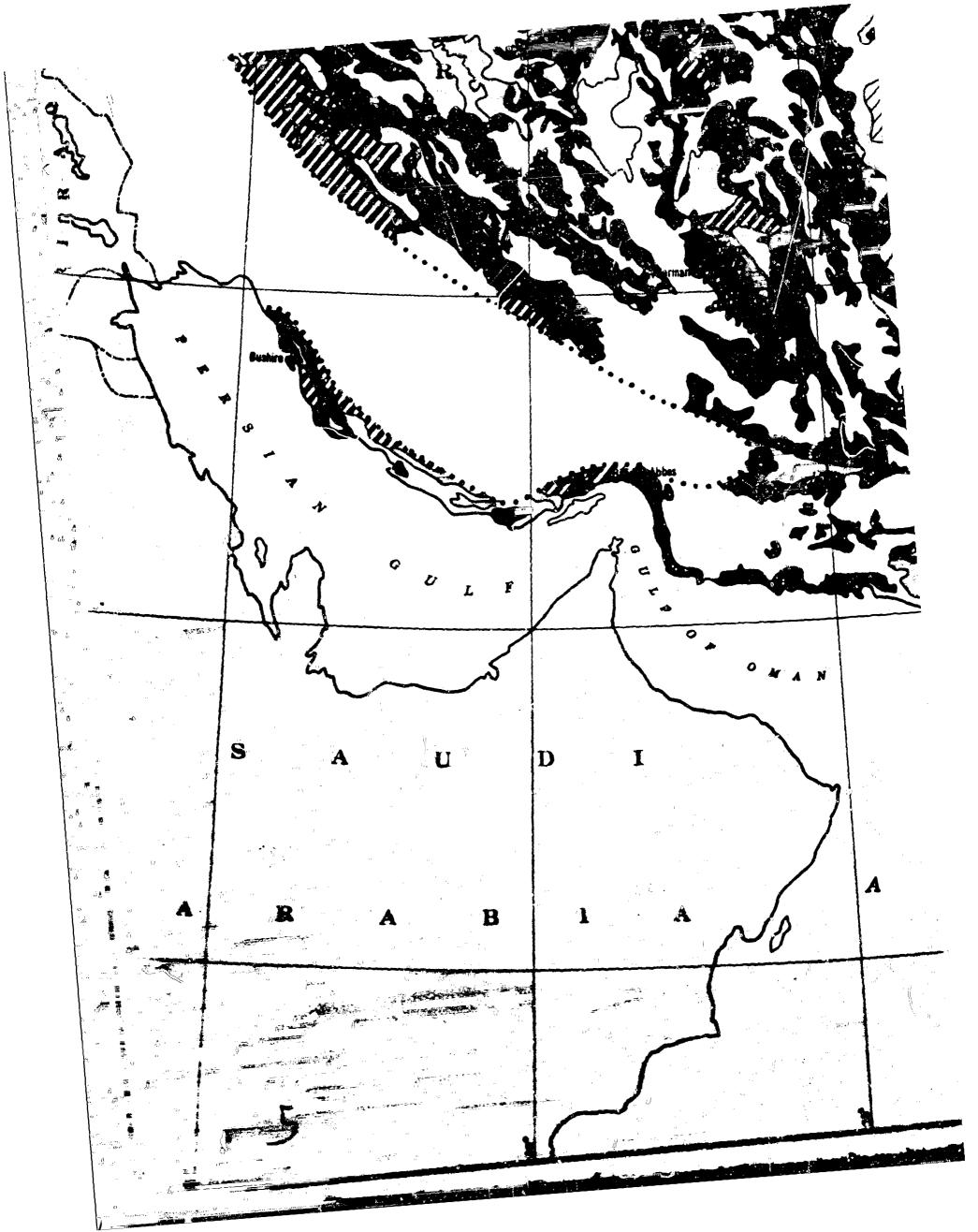
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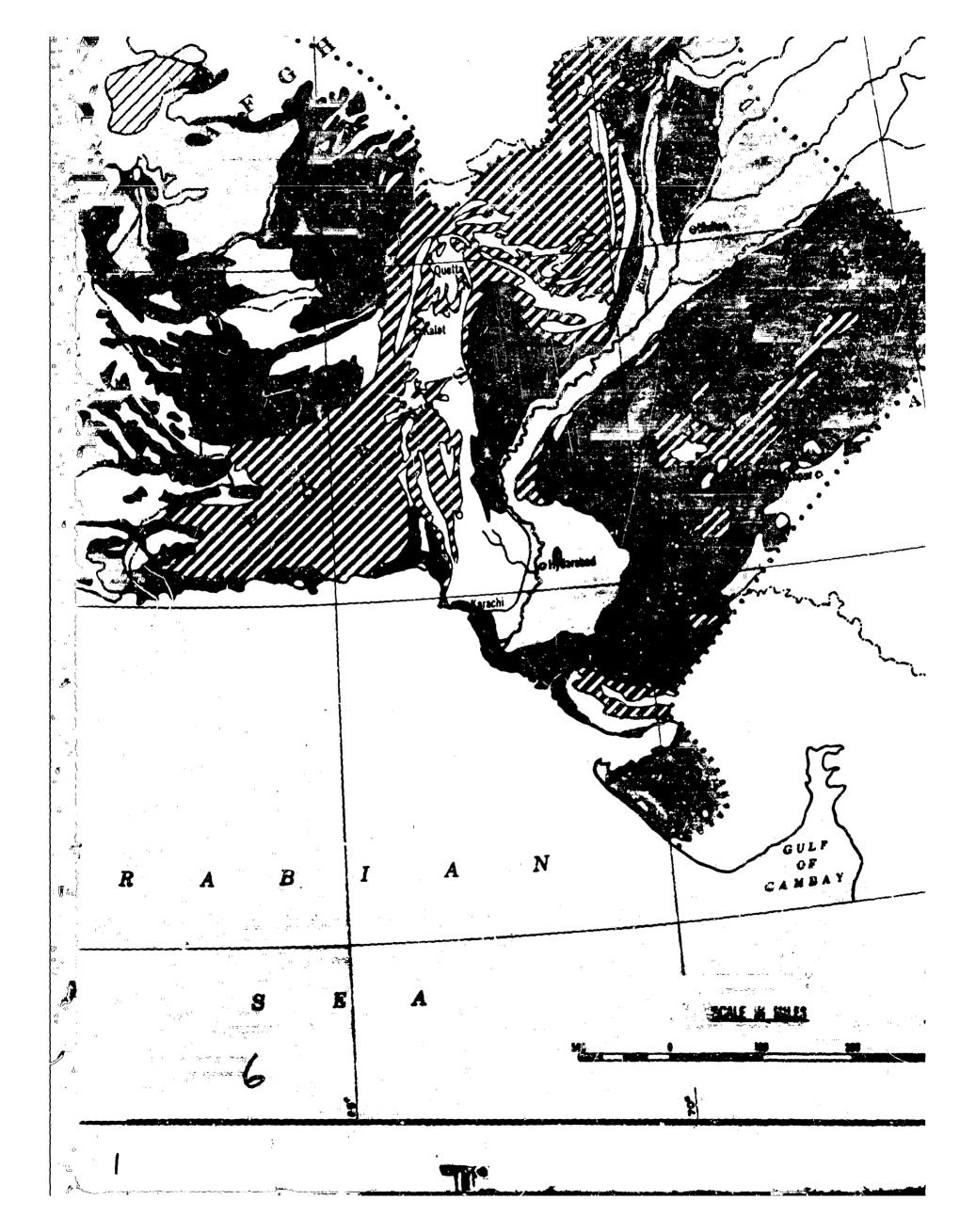


SOIL CONSISTENCY

Sed consistencies are mapped only where suff associations occur, Areally predominant (70 per cent or more) soil consistency mapped.

- HOMOGENEOUS CONSISTENCIES. Soils of essentially unchanged consistencies to depth greater than 12 inches.
 - A. Noncobesive: Materials in which the constituent particles
 - Leoce. The ratio of voids to constituent grains is close to a naturally occurring maximum, i.e., the grains are leocely packed.
- Denoe: The ratio of voids to constituent particles is close to a miturally occurring minimum, i.e., the grains are closely packed.
- B. Cohesive: Materials in which the constituent particles adhers to each other, either because of mutual attraction of the particles themselves, or because of the presence of a communic material.
- 3 Soft (usually perennially well): Little or no bearing terrecity.
- 4 Firm: Medicate bearing capacity.
- 5 Hard: High bracing capacity.
- EL LAYERED COMMETENCIES. Soils pressuring two or more rolatively discrete layers within 12 anches of ten surface.
 - A. Crusted Burincon: Surface crust may be either cohesive or
- hard this crust (coc.menty of comented mesoric.e) see lying soit materials (comments much, once, or externed stite).
- 7 Part crust (commanly of contested materials) ever lying nuncohesive material (commanly used or
- This sees of first materials ever assessment materials. (Most common development is areas of fired dance, with more or less continuous regristments.)
- Parface of C...soly-fished nancehouse publics or gravel sweet, ug ancechouse materials (commenty spand or sally, (Buth "desort pavaments" also ofcur ever bedrets or materials of firm consistentian, but the is less corpuss.)
- B. Responence surface layer loss than 12 recipes that





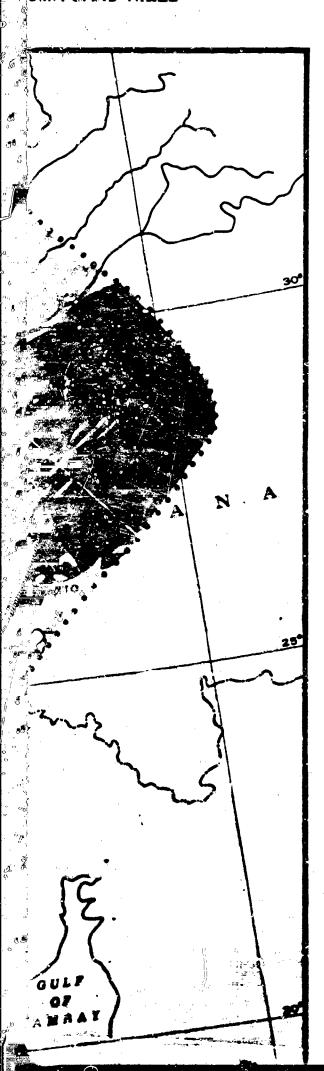




SCALE

YUMA TEST STATION



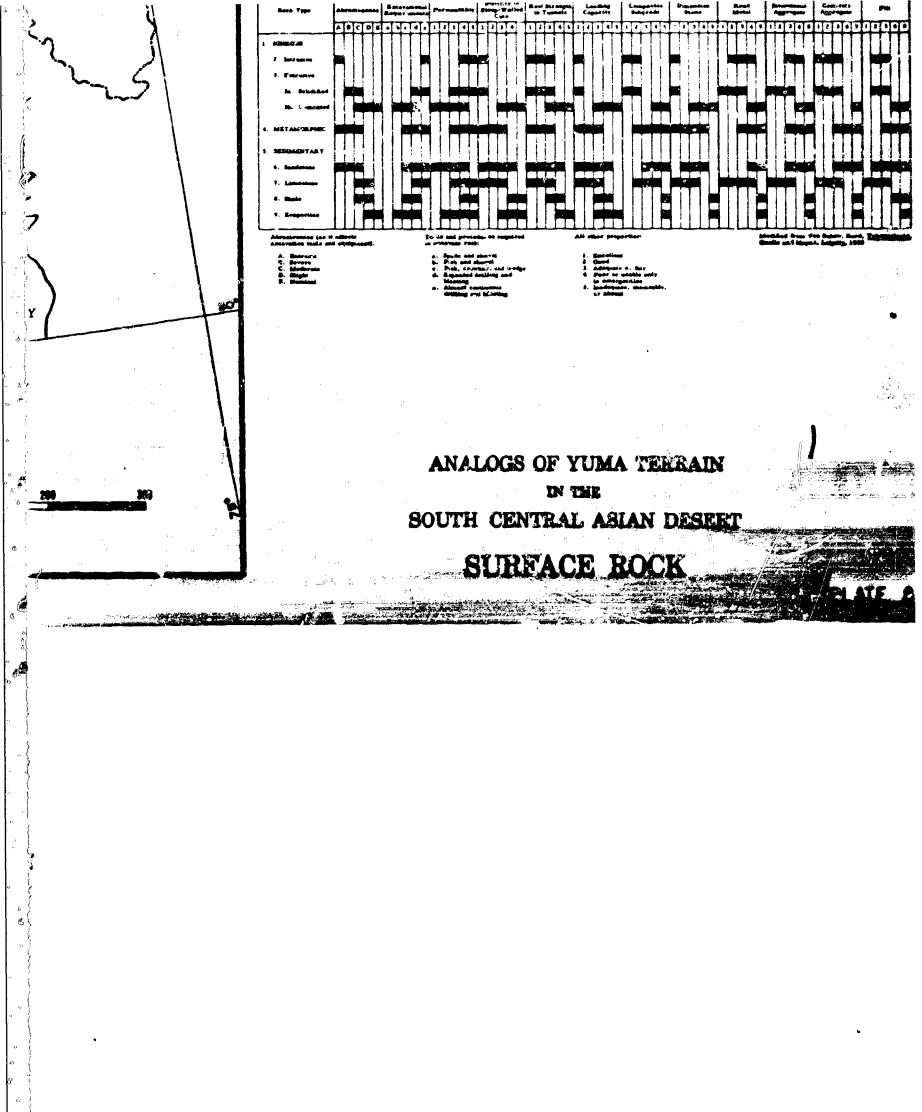


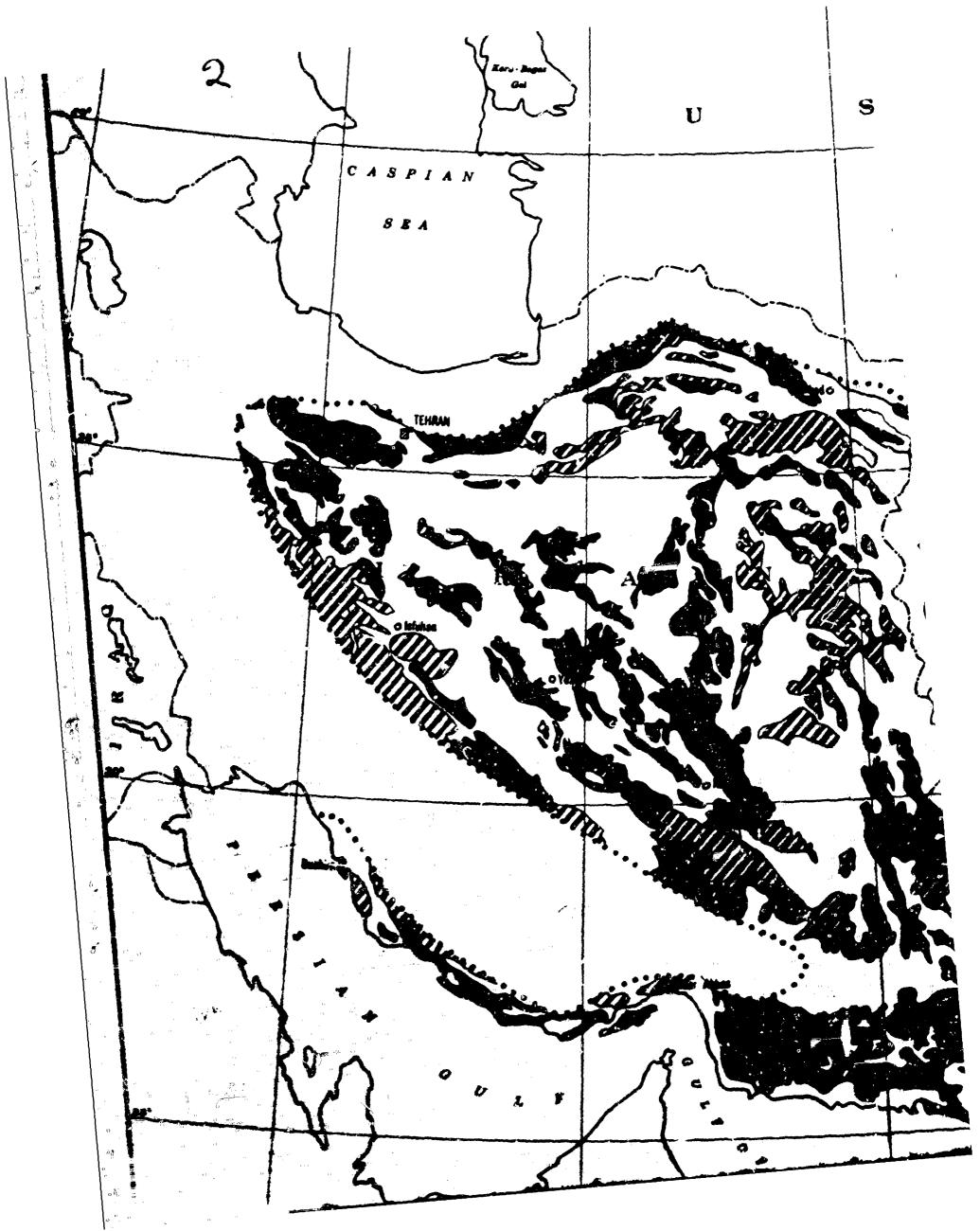
SOIL CONSISTENCY

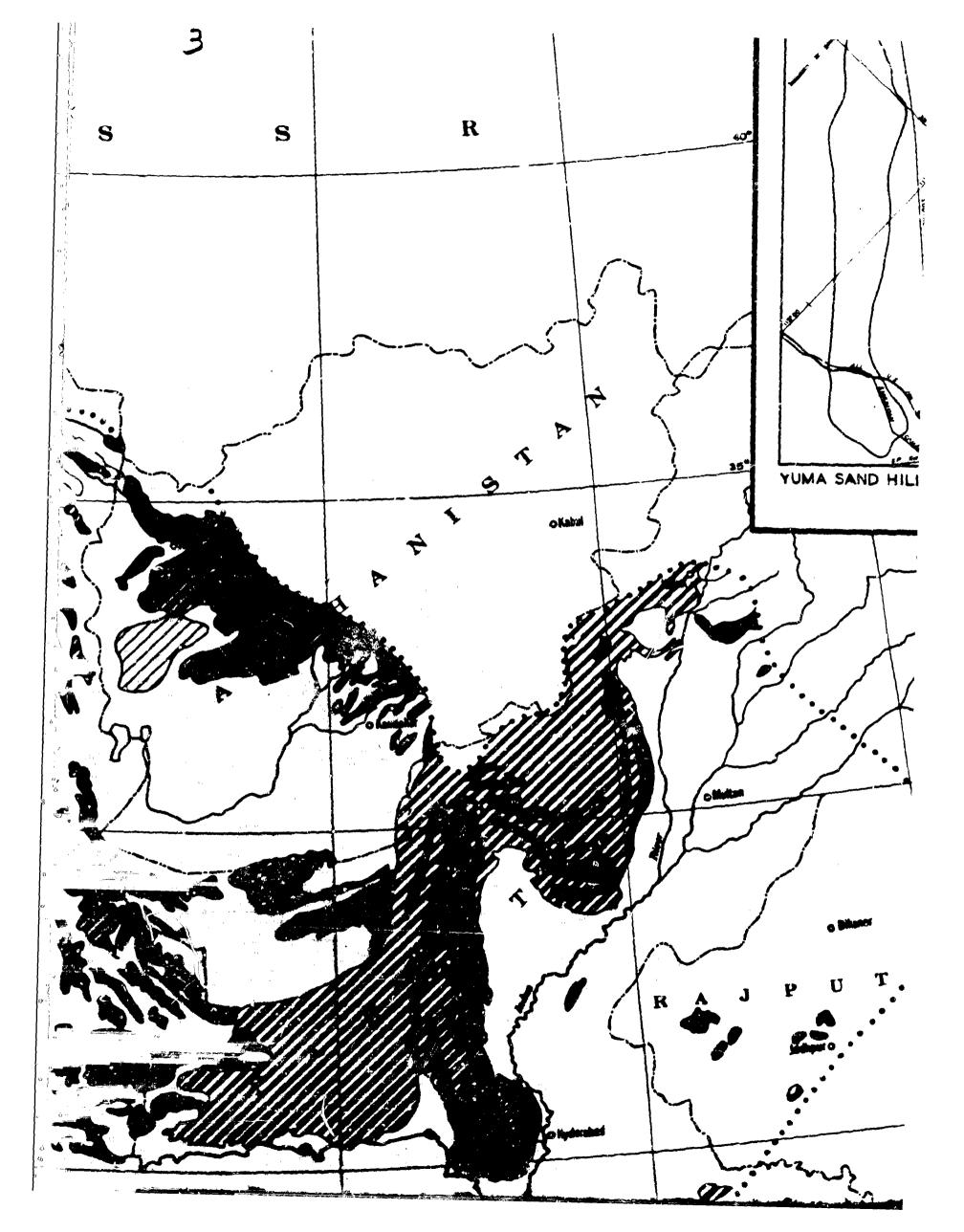
Soil consistencies are mapped only where soil associations occur. Arnally predominant (70 per cent or more) soil consistency mapped.

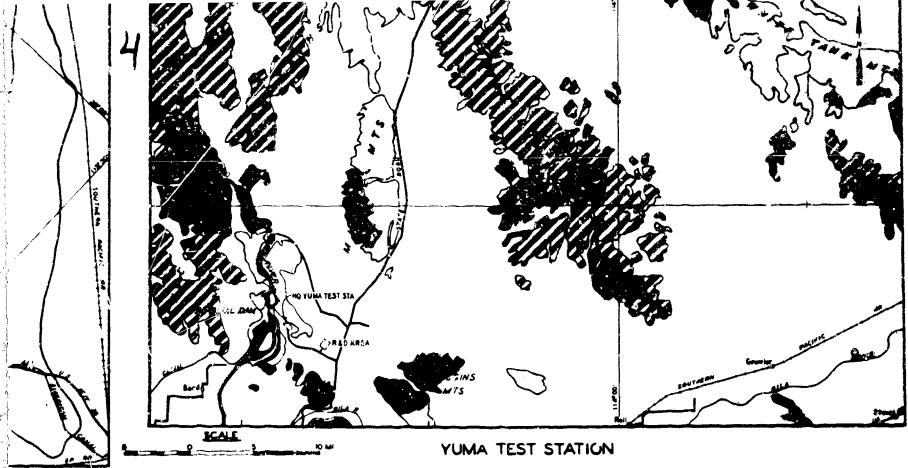
- L. HOMOGENEOUS CONSISTENCIES: Soils of essentially unchanged consistencies to depth greator than 12 suches.
- A. Noncoheaive: Materials in which the constituent particles do not adhere to each other.
- Loose: The ratio of voids to constituent grains is close to a naturally occurring maximum, i.e., the grains ere loosely packed.
- Dense: The ratio of voids to constituent particles is close to a mourally occurring minimum, i.e., the grains are closely packed.
- B. Cehesive: Materials in which the constituent particles adhers to each other, either because of mutual attraction of the particles themselves, or because of the presence of a cementing material.
- Soft (usually personnially wet): Little or no bearing capacity.
- 4 Firm: Moderate bearing capacity.
- 5 Hard; High bearing capacity.
- II. LATERED CONSISTENCIFS. Soils possessing two or more relatively descrete sayers within 12 links of the suiface.
 - A. Gruetod Burlacos: Surface Crust may be either cohecive of meacohosive.
- hard this crust (commonly of commonted materials) overlying soft materials (commonly much, nose, or estarated elits).
- Jying auacohesive material (comments and er mili).
- Tain none of firm materials over noncohesive matefiels. (Most common development in areas of fixed dense, with more or less continuous vegelation cover.)
- Surface of closely-fisted nearcobasive pobbles or grave! overlying nose observe materials (community send or salt). (Such "desert parentests" also occur over her och or materials of firm consistencies, but this is less committee.)
- B. Heacohesten surface layer less than 12 inches thick
- Sense layer within 12 inches of the serince.
- Here layer within 12 inches of the surface (admily in
- COMMETENCY COMPLEXEM: Cometen; by a singlement are mapped where on at eatily prodominated (**O per cost or more) constances occurs. In ottel (a.in. wee, the more more elementally occurring constitutions on the prodominant is shown as the superimane, the subordinate as the describator in the fractions).

In complemes (e.g., 3/4) the first digit always refers to the account year.









SAND HILLS

hiapped in regions where rock is exposed and at shallow depths (i.e., 0-10 feet)* throughout the remainder of the area. In effect this procedure restricts the mapping of surface rock to aroas mapped as 1, 2, or 3 under Seil Type,

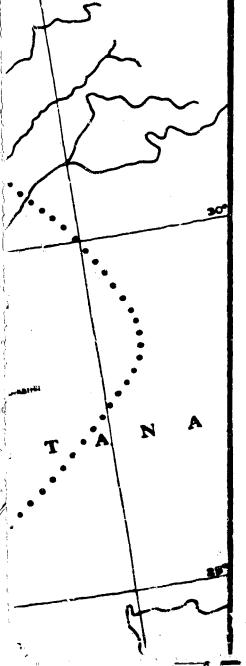
SURFACE ROCK

Areally predominant (70 per cent or more) rack type mapped,

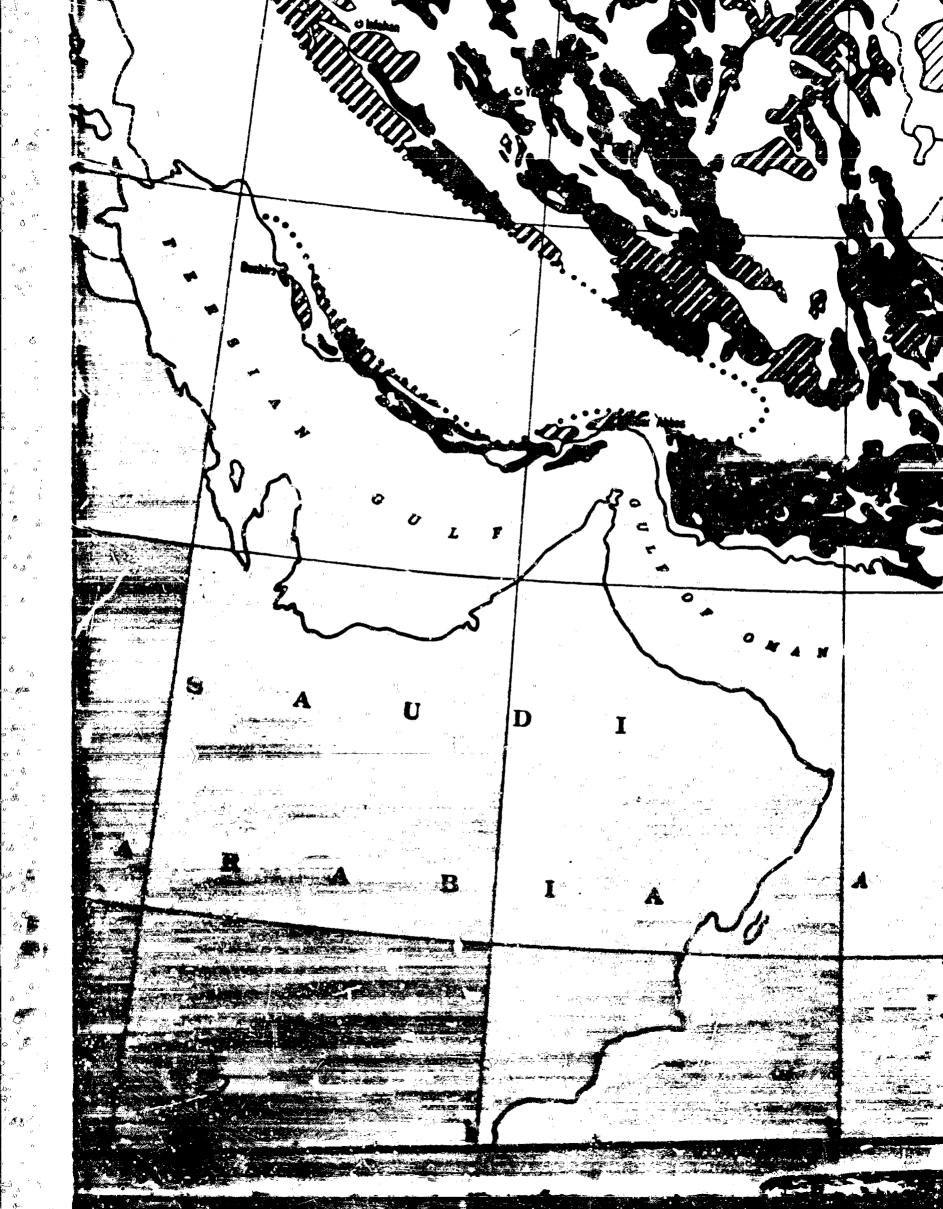
- 1 IGNEOUS (UNDIFFERENTIATED): Rocks formed by solidification or crystallisation of u hot fluid mass.
 - Intrusive: Igneor's rocks, typically crystalline, which have formed by cooling below the surface of the earth.

 (Grante, syemite, district, etc.)
 - surfrusive (undifferentiated): Igneous rocks which have formed by realing at the surface of the earth.
 - True autrusive rocks terried by selidification of molten material that you; ed out on the surface of the earth (e.g., basell, daute, etc.).
 - Rocks formed by secondary contentation of least deposits of volcanic ejecta (e.g., sall, agglomerate, etc.).
- METAMORPHIC (UNDIFFEREITIATED): Ruchs formed from original ignous or ordermatary rocks through alterations produced by pressure, best, or the infiltration of other materials a depths below the surface some of weathering and committies. The alterations are pufficiently complete throughout the body of the rock to produce a well-richard new type. (Guess, eclist, sinte, etc.)
- SEDIMENTARY (UNDEFFRENTIATED) Rocks formed from material laid down in a more or less finely divided saids, as sediment, through the agency of water, wind, or glacters.
 - Sendsione: A entimentary cock prodemignatly demposed no stand grains companied tagether.
 - Limestone: A sedimentary rock consisting accomtally of calcium. carbonate.

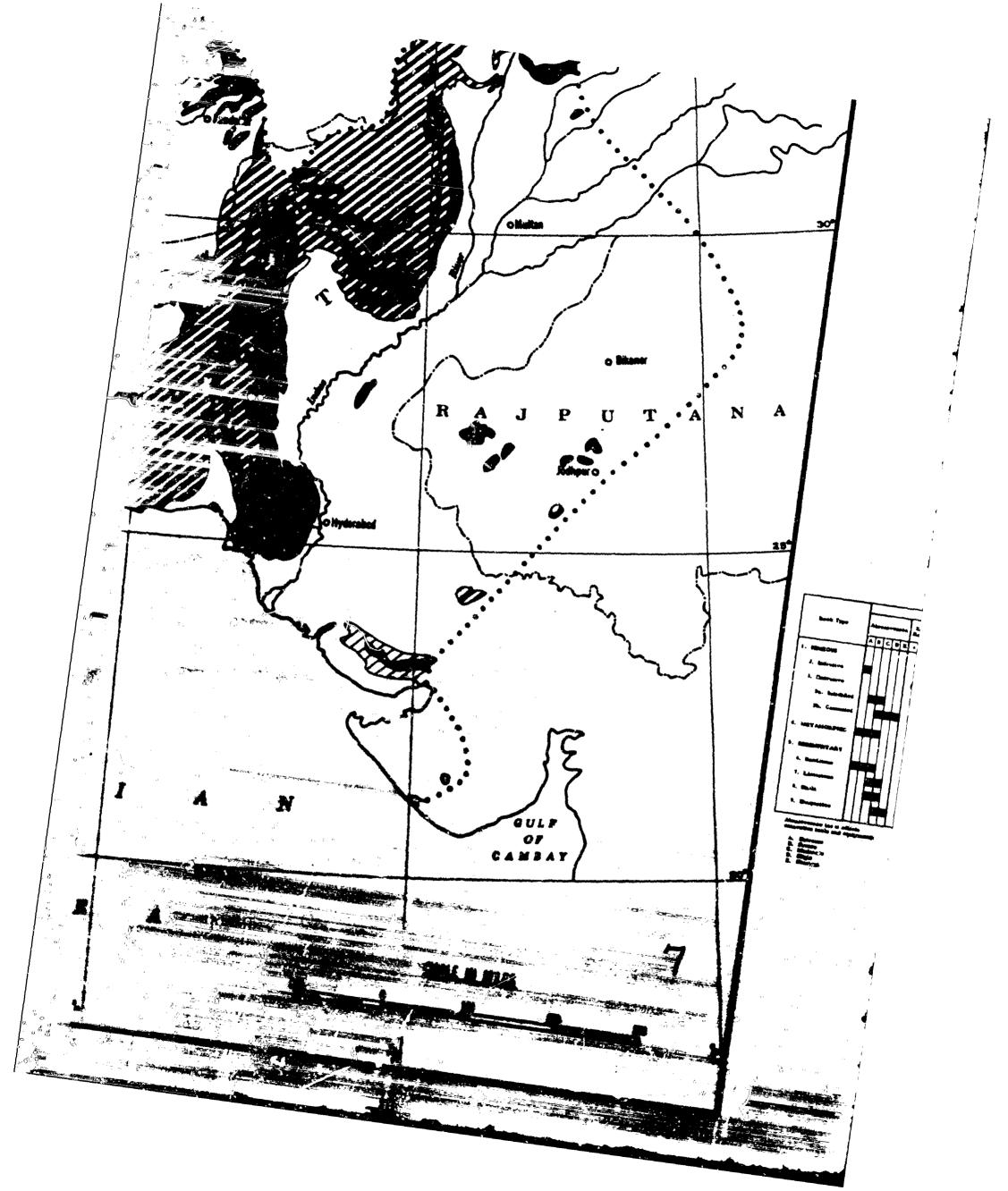
 Shale: A sedimentary ruch is which the constituent parti-
 - Evaporation: A sedimentary rock whose origin is largely due to evaporation and subsequent proceptions of solt from water. (Gypount, askydrite, and rock exit are the unity evaporation of grantitative importance.)
- Baylo BCCS COMPLEXE: Such completes of a mapped where a seally predominant (70 per Cost or more) ruch type occurs in each instances, the two meet comments accurring ruch types are mapped, the predominant is above as the temperator, the ockerdinate as the department in the fractional
 - 4 should be realized that the erate of mapping precisely delignation, especially in mountainous regions, of many allowed because where the Wichmood of sets cover to much greater than 10 R.

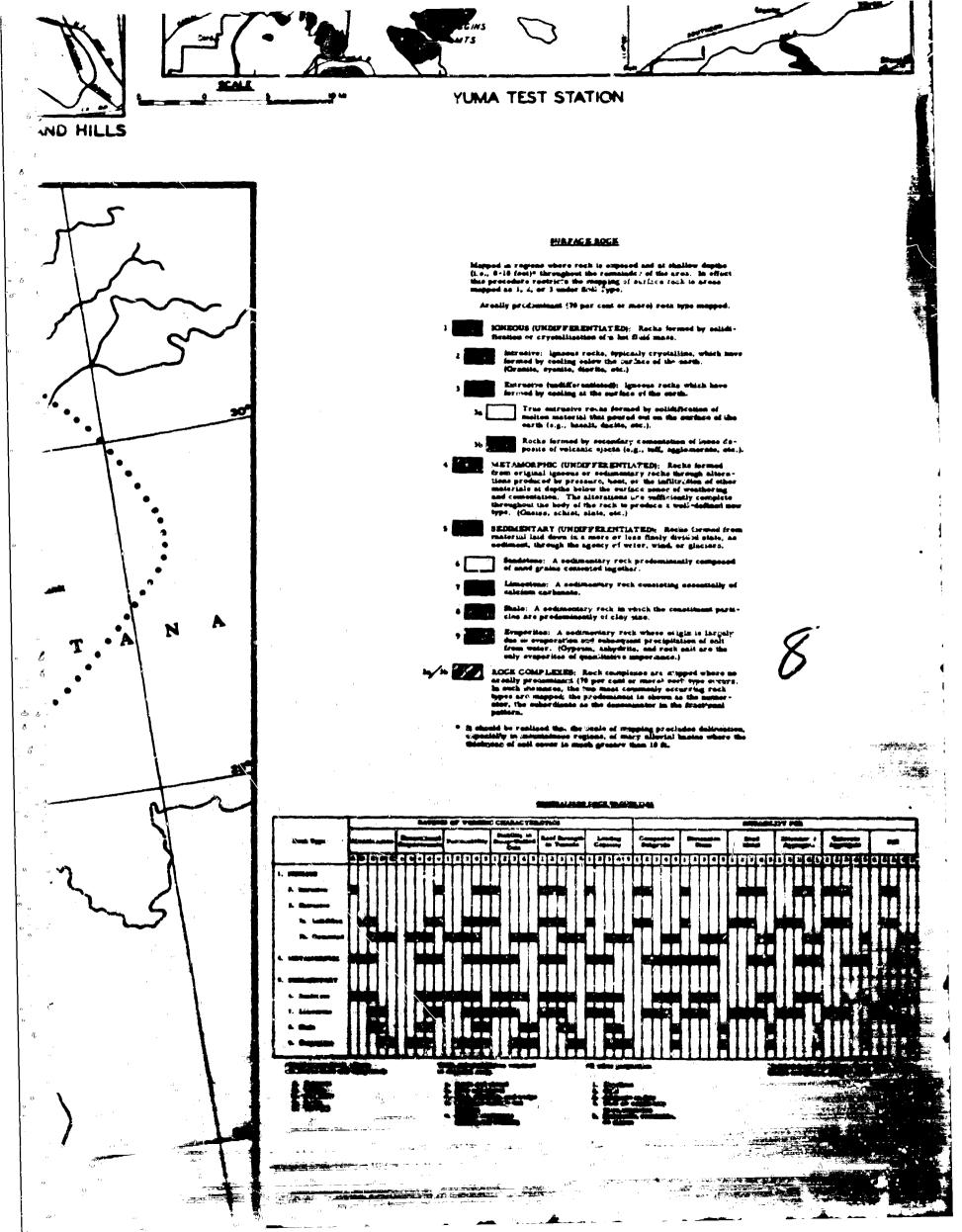


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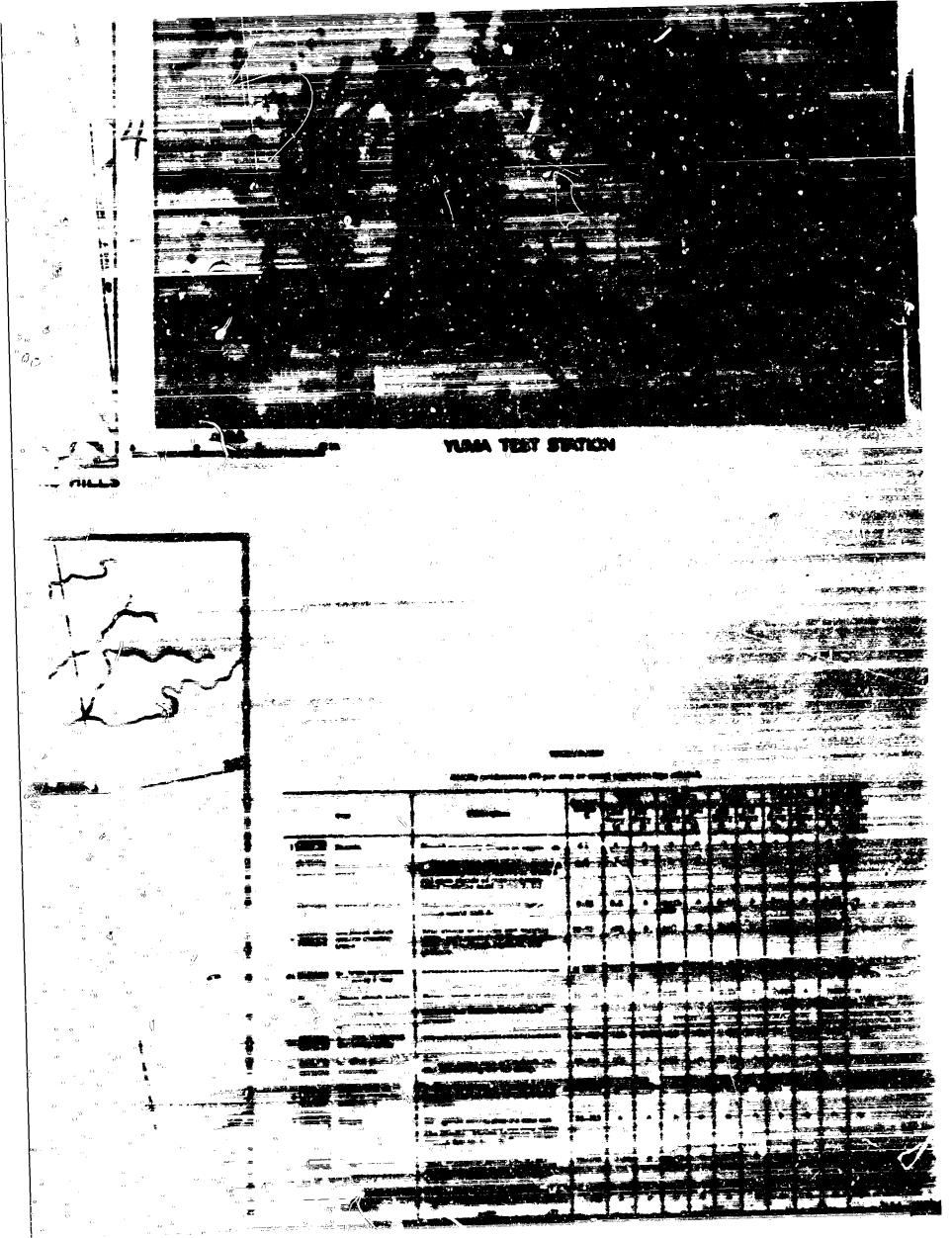
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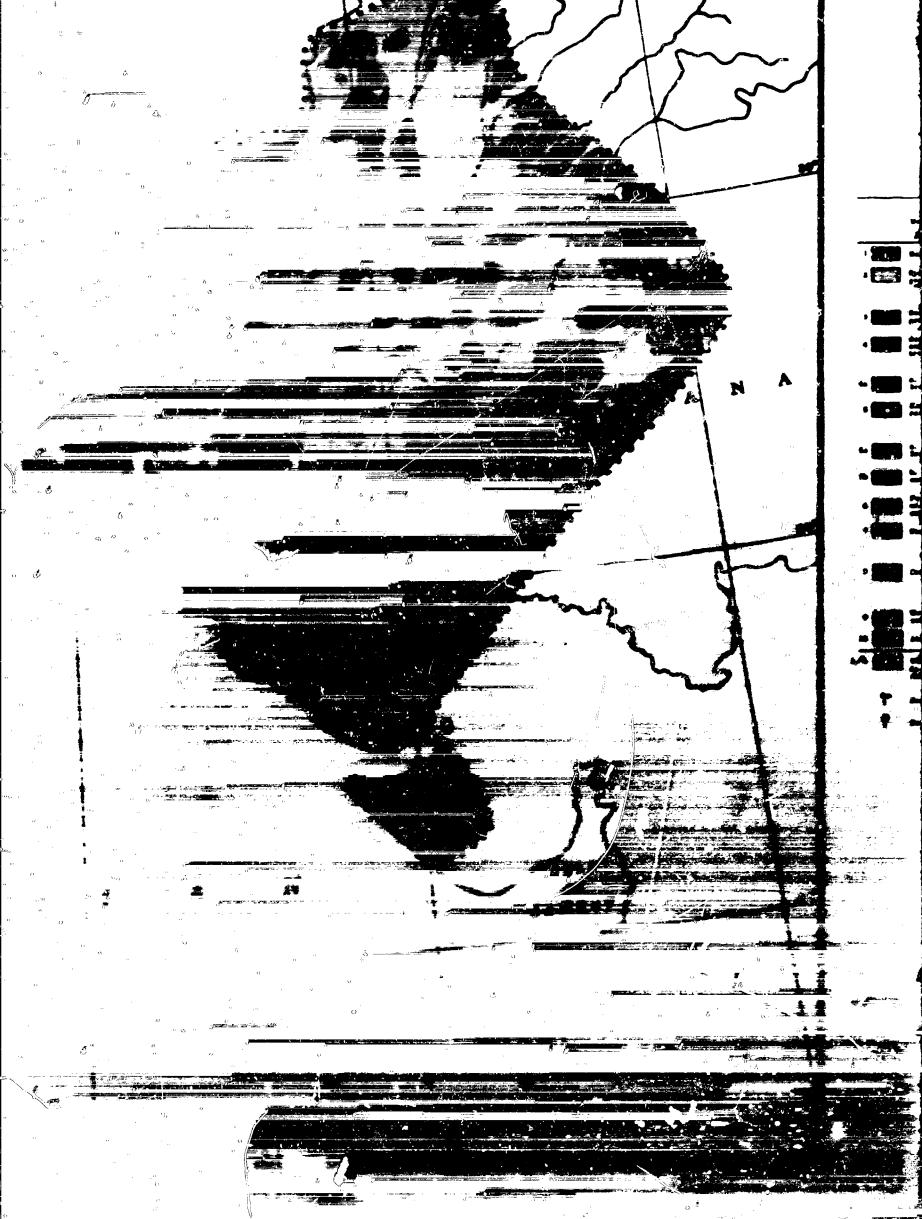










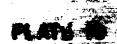


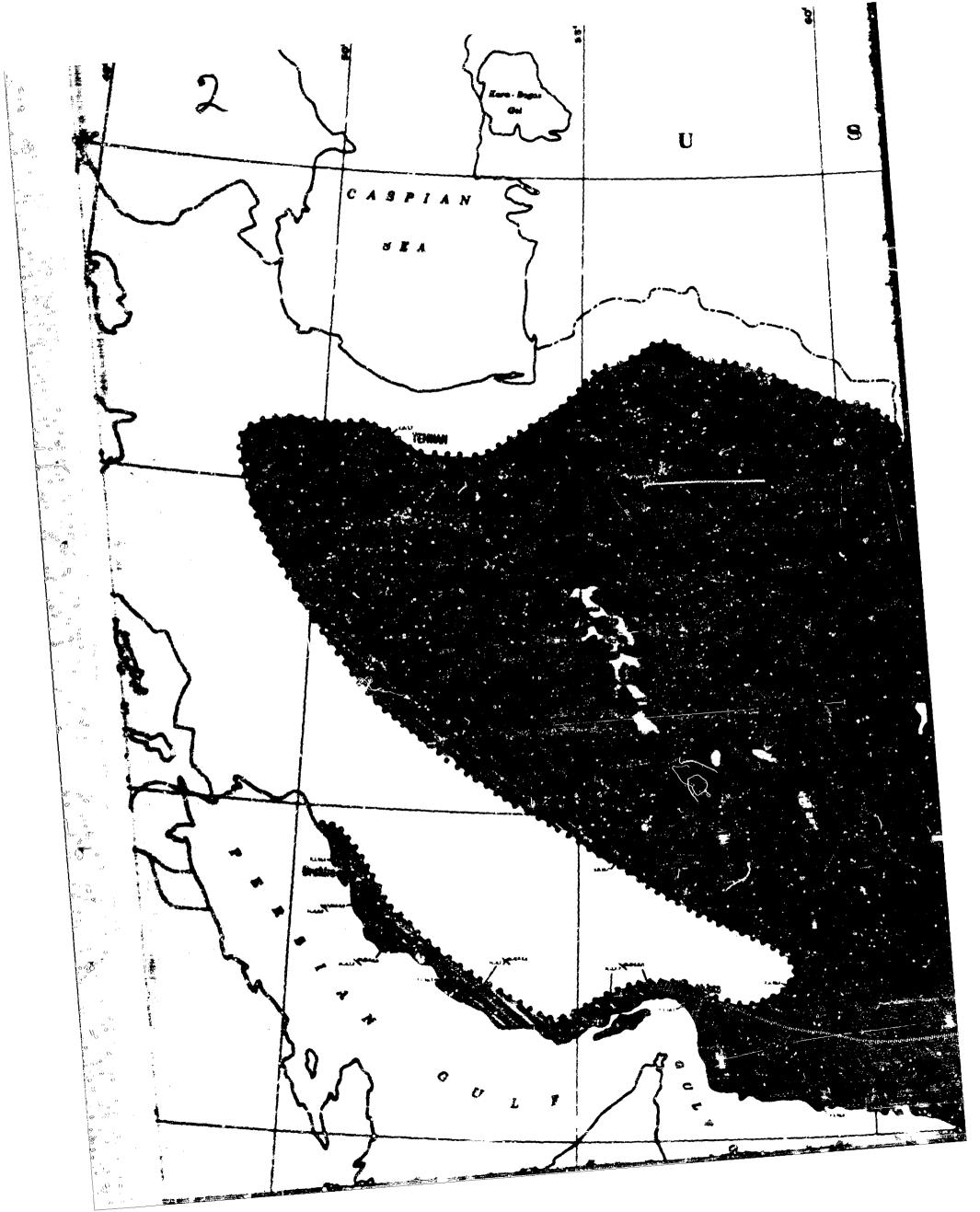
GLOMETRY OR FORM AS ALOGS

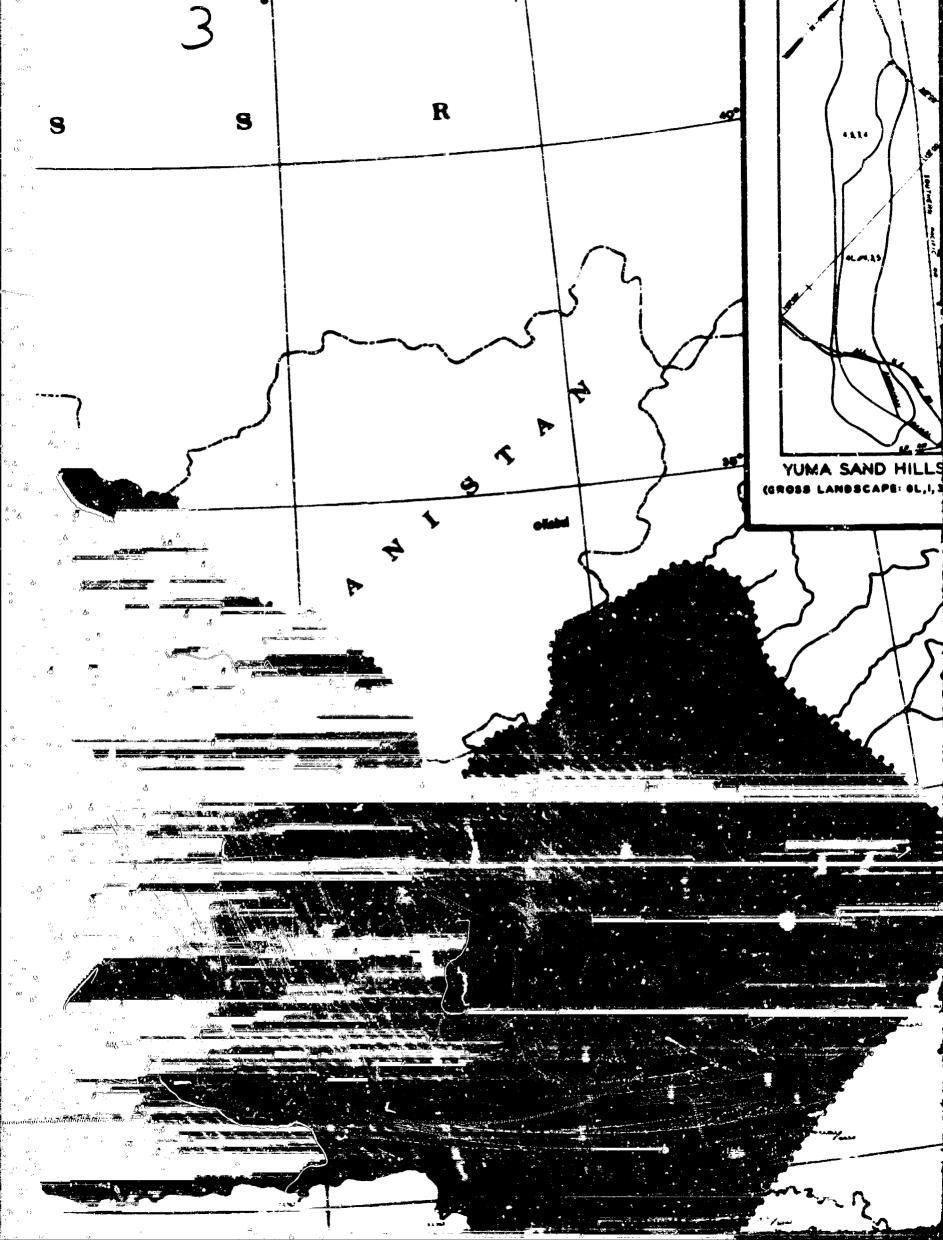
	LEGEND			
Each landscare type is identified by a serian or an erray of four symbols tasticating mapping units of PLAN-PROFILS (4) SLOPE OCCURRENCE (5), SLOPE (3), and RELIEF (5). Mapping units of these four factors are always designated in this order.				
Landscapes in South Central Asia are always compared with Yuma landscapes amout vice versa. The array of symbols in South Cantral Asia is shown in light- as budface type to institute the maximum degree of analogy with Yuma, the salegy increasing as the number of lightface units increases. Units shown in boldface type are not found at Yuma in combination with the remaining units of the array. Units in lightface type indicate the maximum; number of units found in the closest corresponding array on the Yuma map. *				
Areal Complex. The areally predominant landscape is the numerator of the complex, the autordinate the denominator.				
oss-Component C iy with other gros	omplex. The gross landscape is excircled and is compared o landscapes.			
ghly Analogous	The identical landscape is found at Yurna.			
oderately selogous	The e units of the array are found in an array occurring at Yuma.			
atitiy Miogous	One or two units of the array are found in an array at Yuma.			
t Analogous	No unit of the array is found at Yuras,			
andscape type.				
_ 	indicates the de- andscape type. Indicates the de- landscape type.			

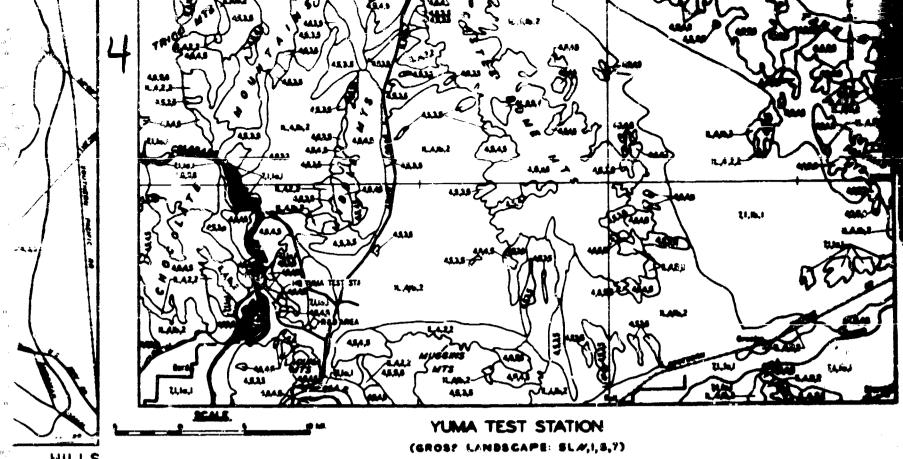
In a particular array it may be possible to shoose different note of light- or holdfore units to indicate the maximum degree of sealory. In such instances units are Congenced in the angler given in the array. For ensemble, the doubt Contral Asia array 7.1.3a,3 was compared with the Yuma array 7.1.3a,3 rather then with Yuma 11,45.2. Comparison with the letter weight have resulted in the anomalization. For 2.2.

ANALOGS OF YUMA TERMANION IN THE SOUTH CENTRAL AMAIN DESERT
GEOMETRY ANALOGS

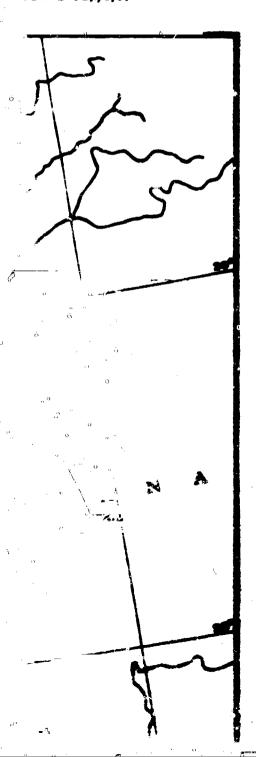








HILLS



GROMETRY OR ACRM ANALOG

LOCAL

4.5.3.5 Buch leaderage type in identified by a series or an error of feur symbols tellcating mapping units of PLAN-PROFILE (4), SLOPE OCCURRENCE (5), SLOPE (3), and RELIEF (5). Mapping units of these four descript are disting des-

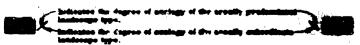
4.4.3.5 Londocapae in South Control Asis, are alve, a computed with Yuma leaderspee and on vice verse. The error of symbols in South Gentral Asis to shown in higher and holdless type to indicate the maximum degree of analogy with Yum;, the sighigy increasing on the number of lightfless crite increases. Butte about in helfiliand type are not found at Yump in combinations with the commissing with of the effect. Unto in lightfless type indicate the mightness number of units found in the clients.

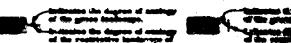
Areal Compton. The areality predominant landscape to the summerable of the sum yies, the extensions the decominants.

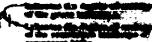
Trees-Compensed Compies. The grees landscape to controlled and to compared and with other press innbrapes.

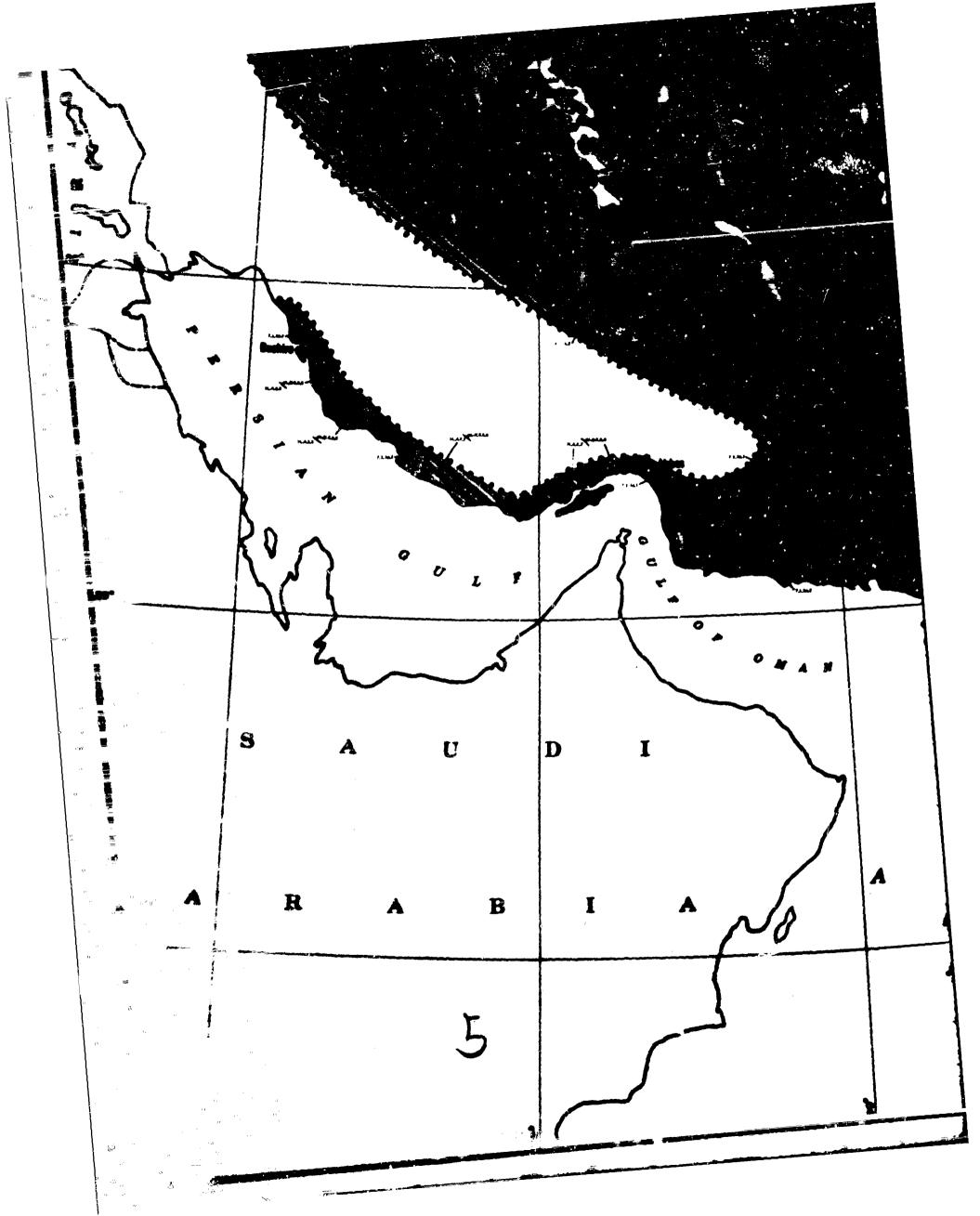
7,4,64,1				
A State Andrews	The Lincolness construction or Supple			
) Medicanty	Three table of the error are fined in an error eccurring at Yuan.			
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• E Hat Analogous	No unit of the error to frant at Pages.			

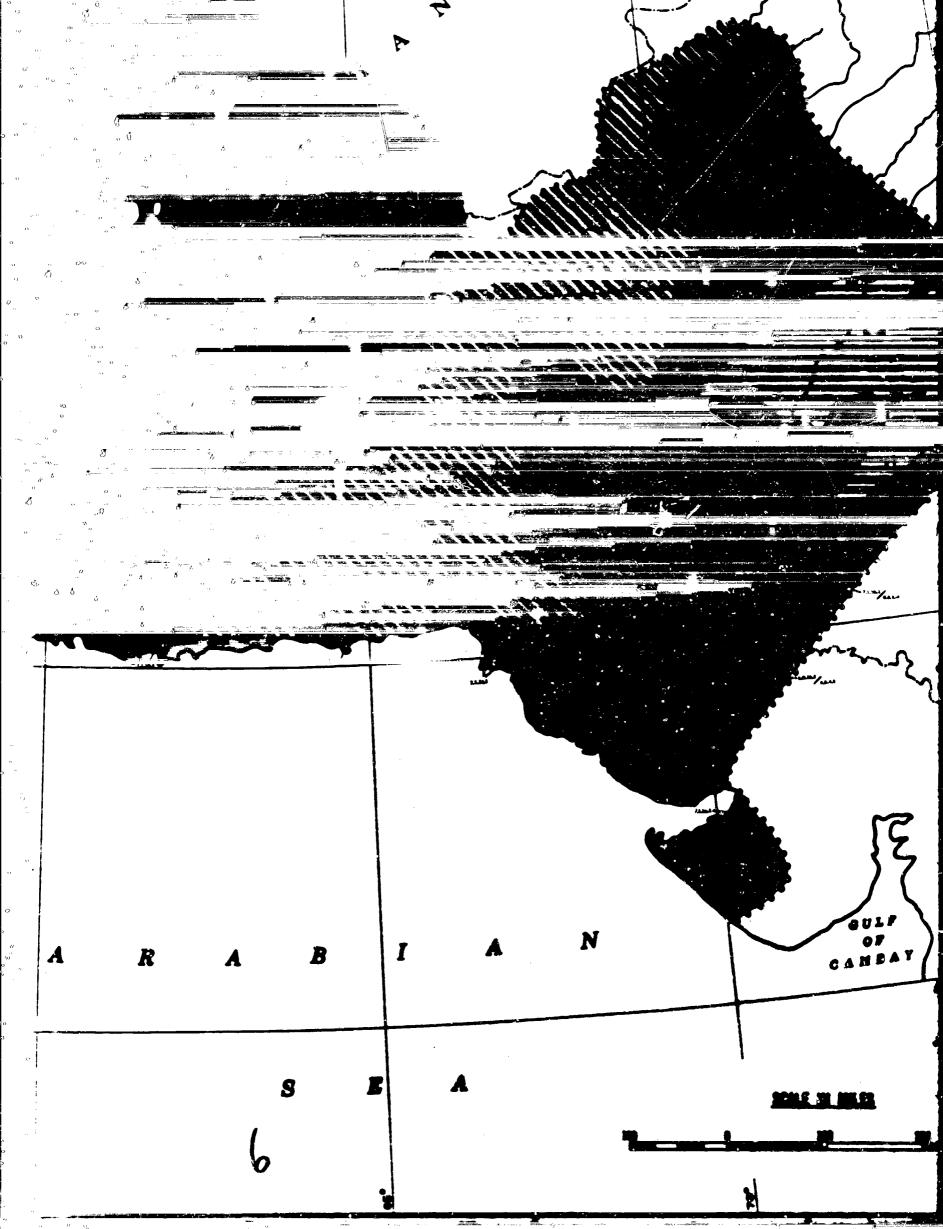
I AMERICANUS CONSISTENCIA

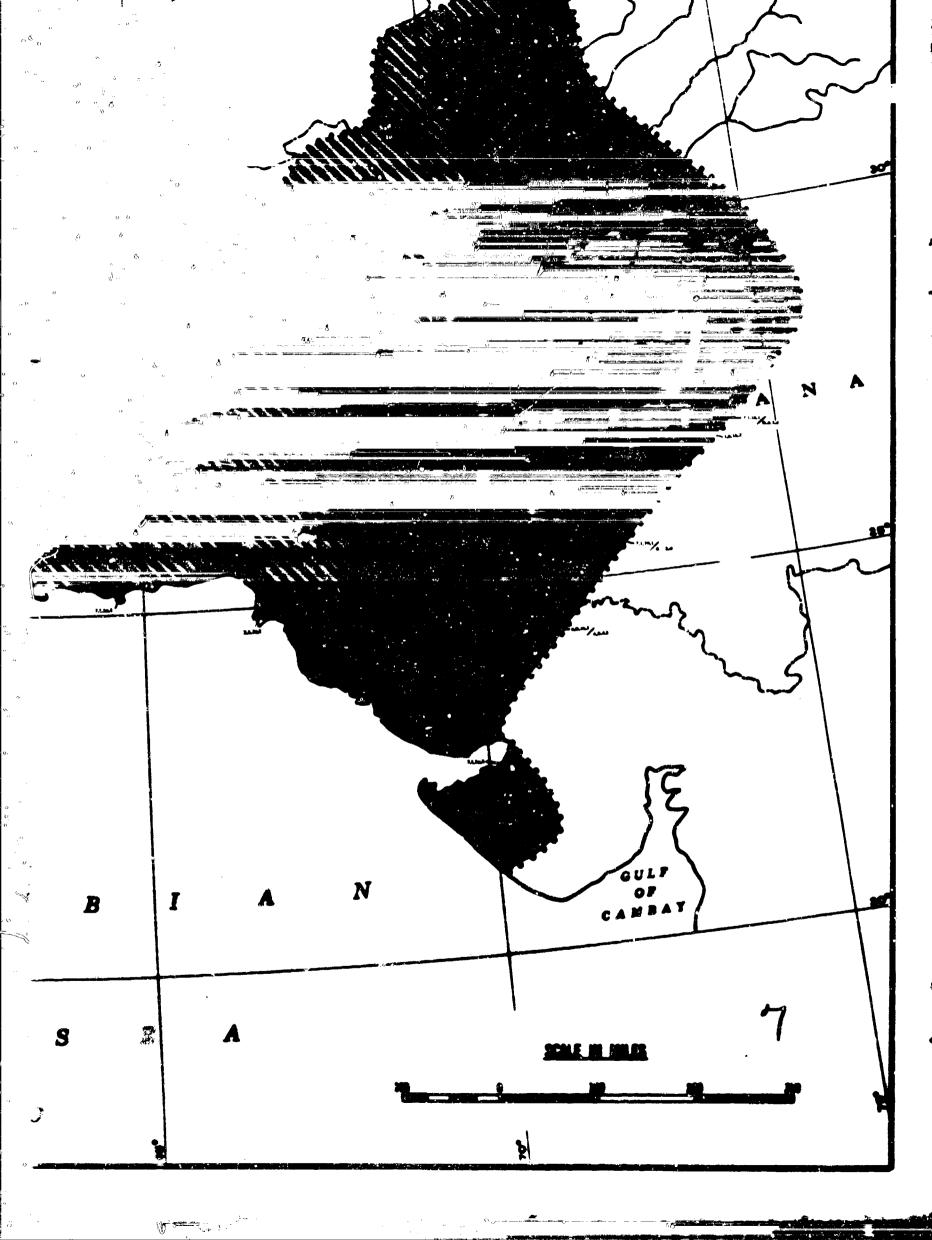












LEGEND

- 1.7 Numbers designate mapping water of self-type and surface rack or delicensistency, respectively. If the self-type (first member) is 1, 2, or 3, its second digit designation a surface-read mapping until if the self-type (first number) is 4 or higher, the second number designates a self-consistency mapping unit. In the example given, e.g. 1,7, the first digit is self-type, the second, surface read.
- 8.5 Ground factors in South Control Asia are airmay compared with Yema ground factors and not view versa. It both digits are lightface, the mate designated are found in combination at Yuma. If one is light, and the other heldface, a combination exists at Yuma containing the highlines with Month dicits are heldface, and they must in female at Yuma.
- 5,1=6,10 indicates area of ground complex. Two definite soil type-curfuce rest or self-consistency combinations are present, but the scale mapping precludes delineation. The ureally prodominent ground factor appears that in the complex.

2	Highly Analogue	Combination found at Yusta.		
· 🗆	Partially Analogous	One of the two units is found at Tuma.		
•	Not Analogous	None of the units are found at Yuma.		

GROUND FACTOR COMPLEXES

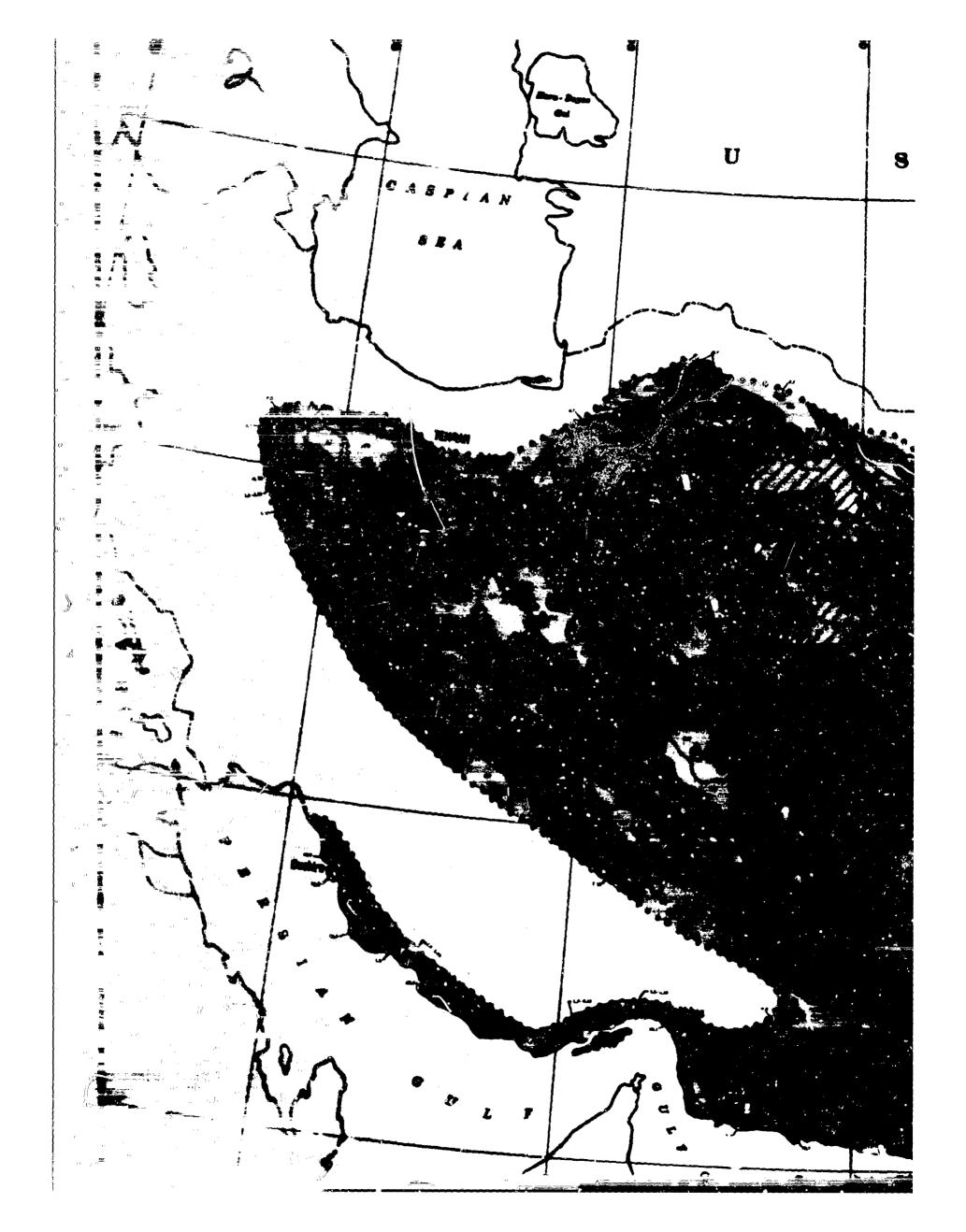


-Indicates the degree of enalogy of the productional graphs factor array.

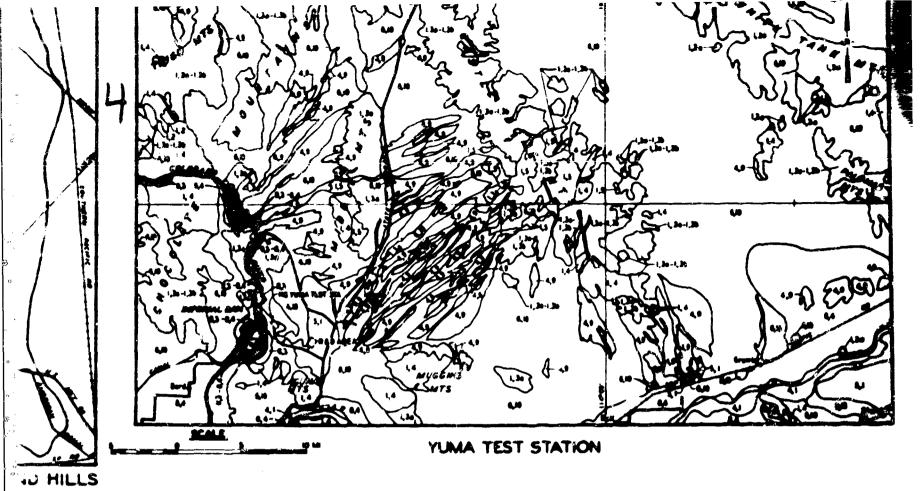
-ladicates the degree of analogy of the subordicate gr/-and fatter array,

At Yuma surface rock unit 5 (ardimentaries untifferentiated) includes units 5, 7, and 8 (andstone, timestone, And shain); therefore, where these units are mapped in Sruth Central Asia, they are designated by lightface symbols.

ANALOGS OF YUMA TERMAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
GROUND ANALOGS







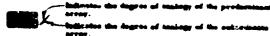
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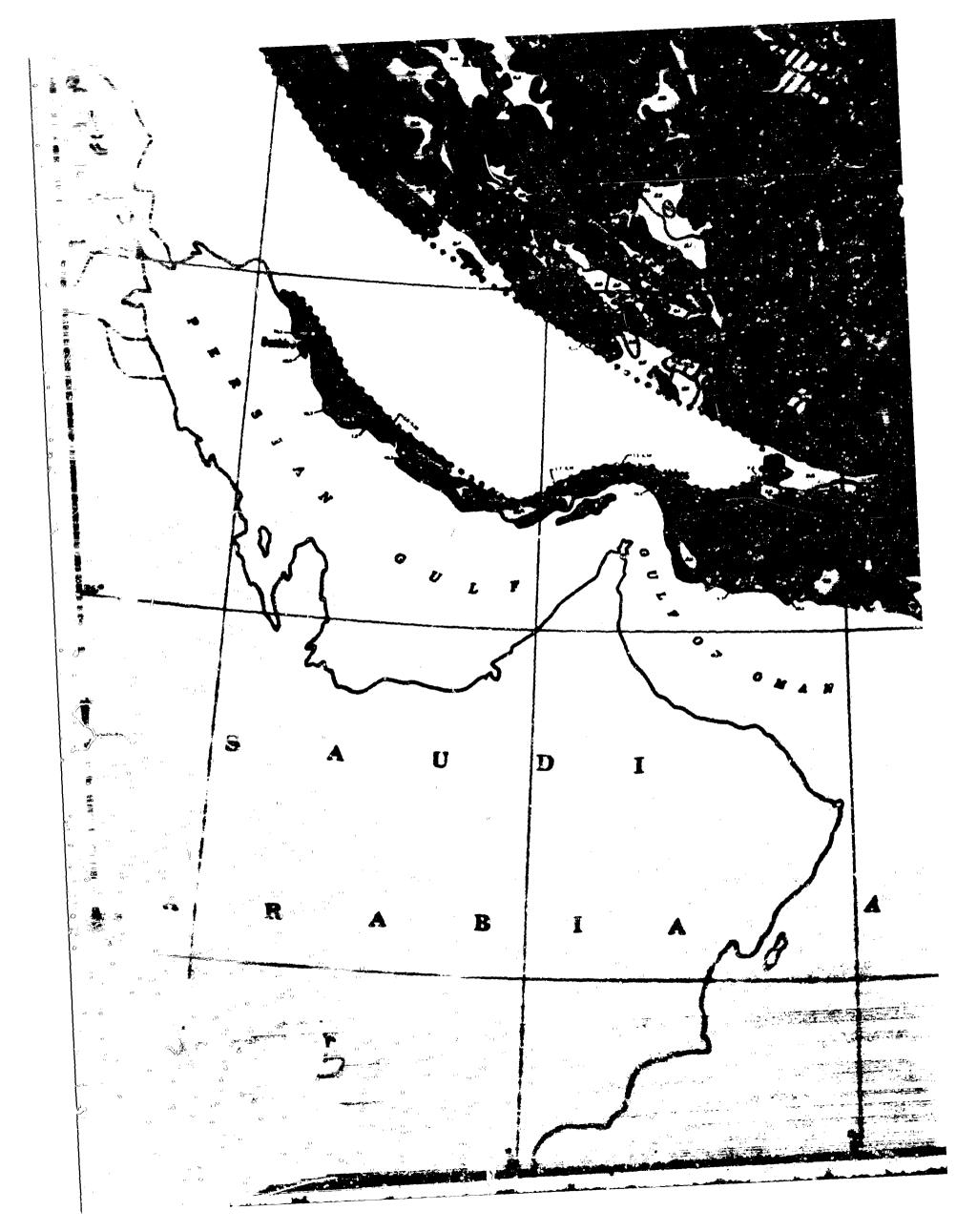
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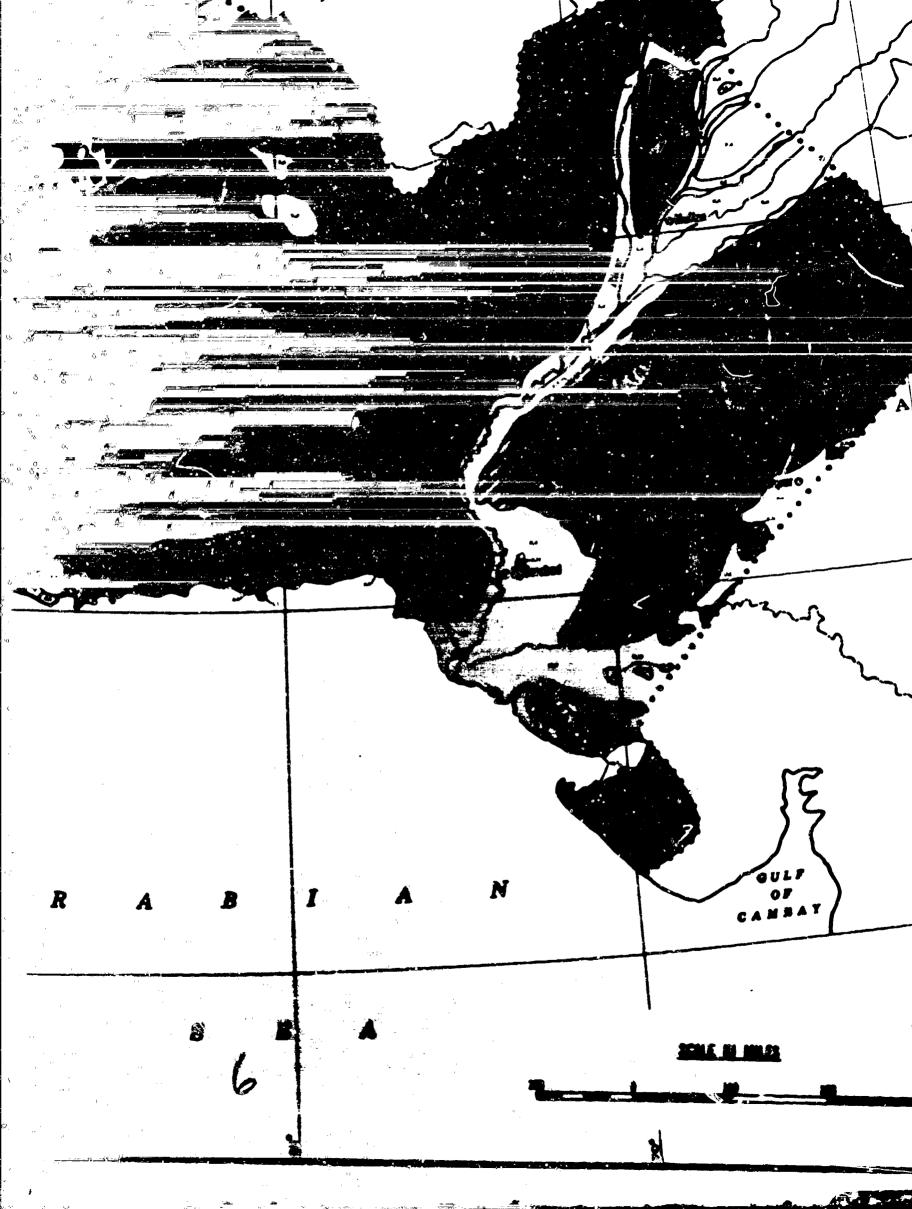
- 1.7 Humbers designate mapping units of onli-type and surdays rook or sell cannotatesty, respectively. If the sell-type (first number) to 1, 2, or 3, the eccent digit designature is units or resping units if the sell-type (first number) to 6 or higher, the second mapping units if the sell-type (test number) as a pair-resolutionary mapping units. In the semantic given, e.g. 1.7, the first digit of the sell-type (test number).
- 8.8 Ground feature at death Control Asia are always compared with Yunia ground feature and not view tures. If both digits are highlane, the value features are from a compared are from a compared out Yunia. If you so light and the other bothlane, a combination at Yunia a sustaining the highlanes with the feature of the compared of the compared out of the compared out of the compared out the comp
- 5.1-6.10 intingen area of ground arrigins. Two definite nell appropriate new or cell-residencely arrelated temporary provides defined by the temporary for the temporary provides defined by the temporary for the tempo

2 Bujley Assertages	Combination fired at Yuma.
Partially Assisgnee	Com of the see units to found at Yuche.
6 Mot Analogous	Hone of the units are found as Youn.

SACTION COMPLETES









ALCE INTERNATIONS

LEGEND

- 4 Number sosignator regulation manufacturity
- 2 Lightface number indicaton that the unit is found at Yumn
 - f Boirface rember indicates that the exit is not found of Tomas
- Indicates area of vegetation complex. The deflette vegetablesial types are present, but the scale of mapping procludes delineation. The creatly produminant reputation true armans from in the manufacture.

: 1	Highly Analogous	Unit in and at Yuma.
	Net Amlegous	Unit not found at Yesta.

VEGETA /ION CONTRIBUTE

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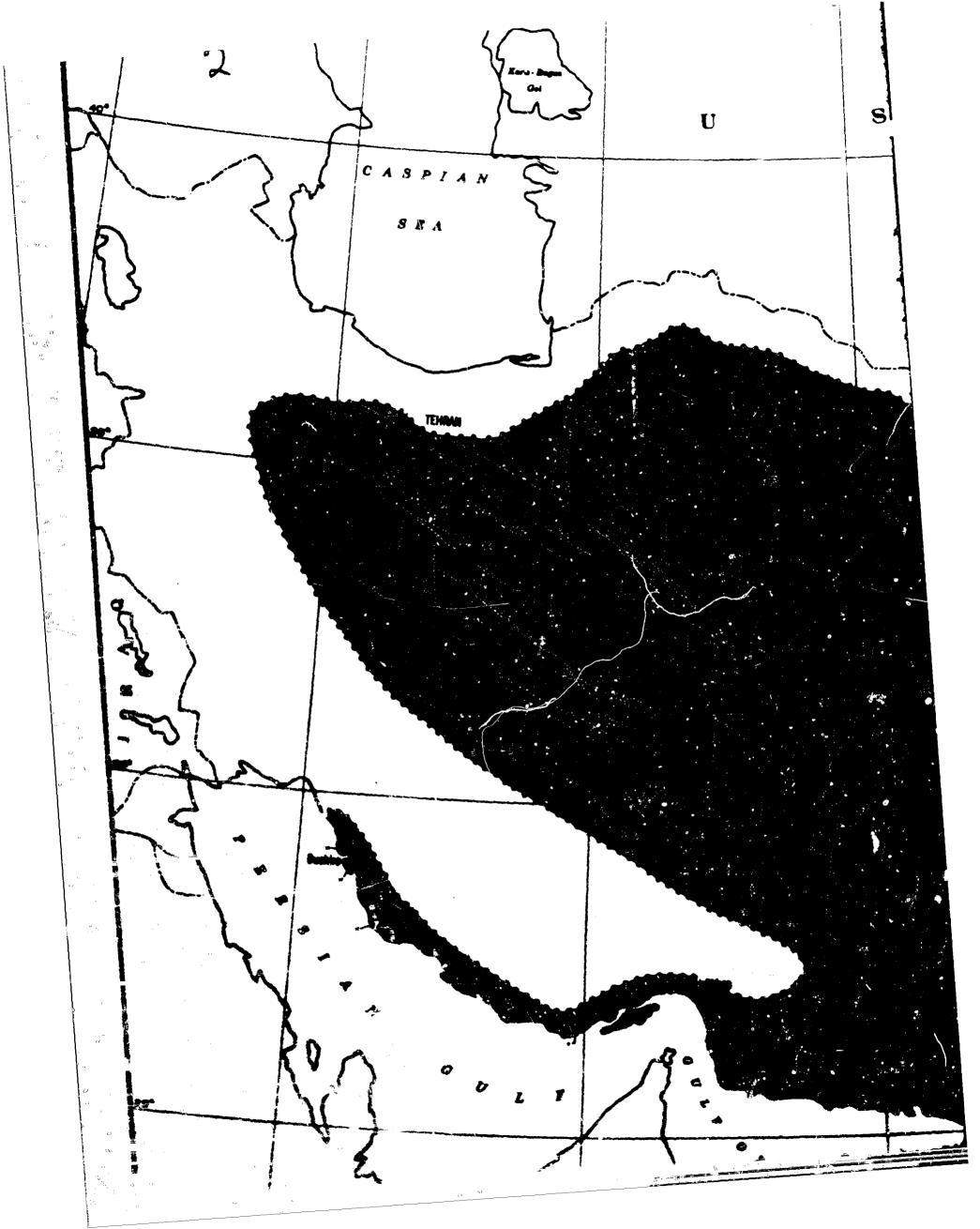
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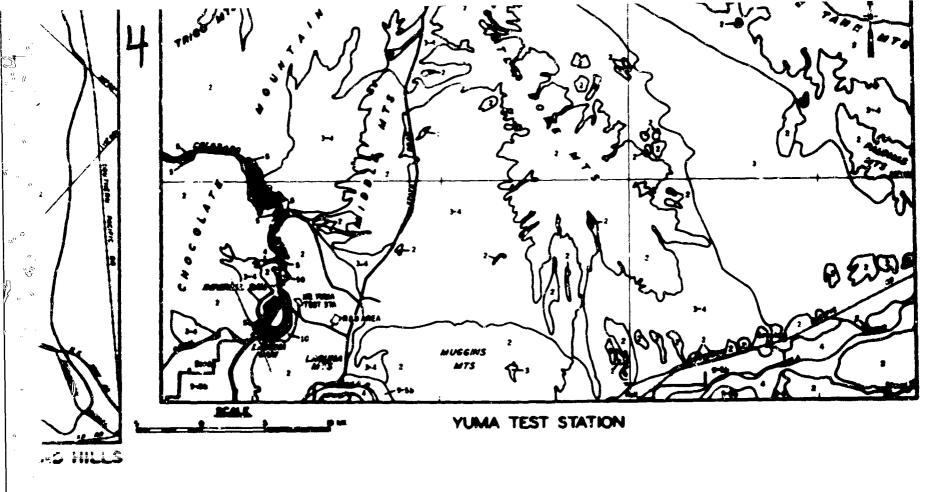
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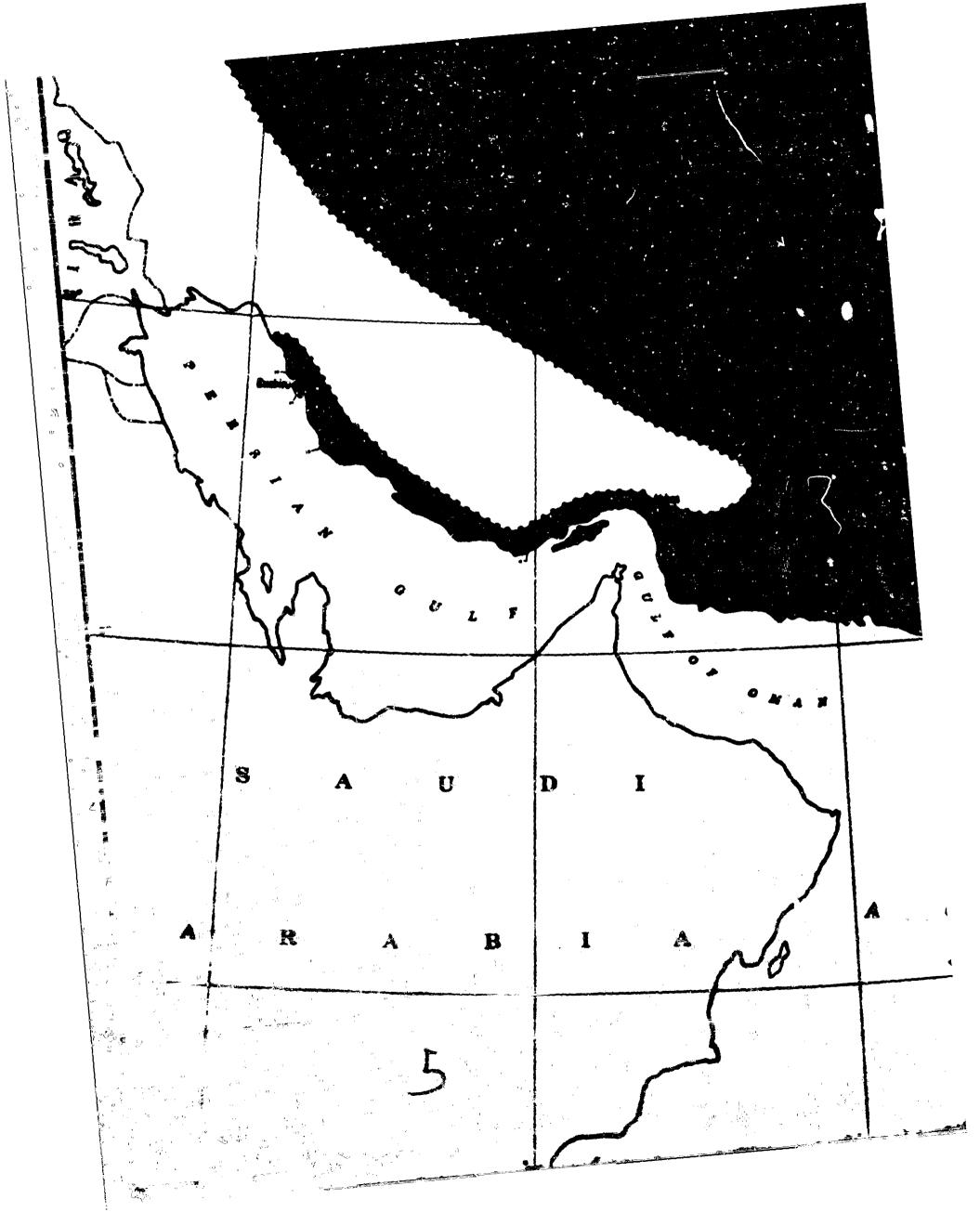
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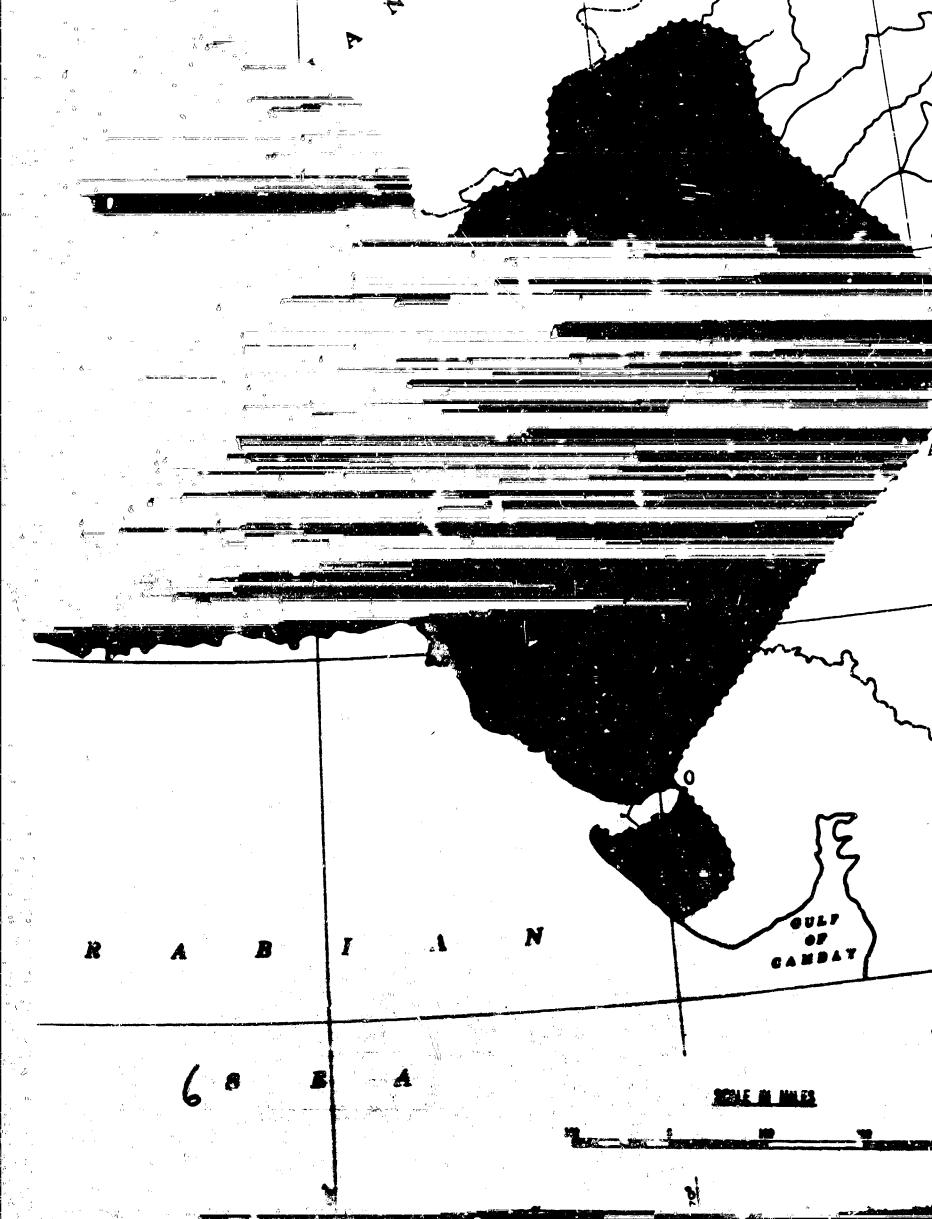
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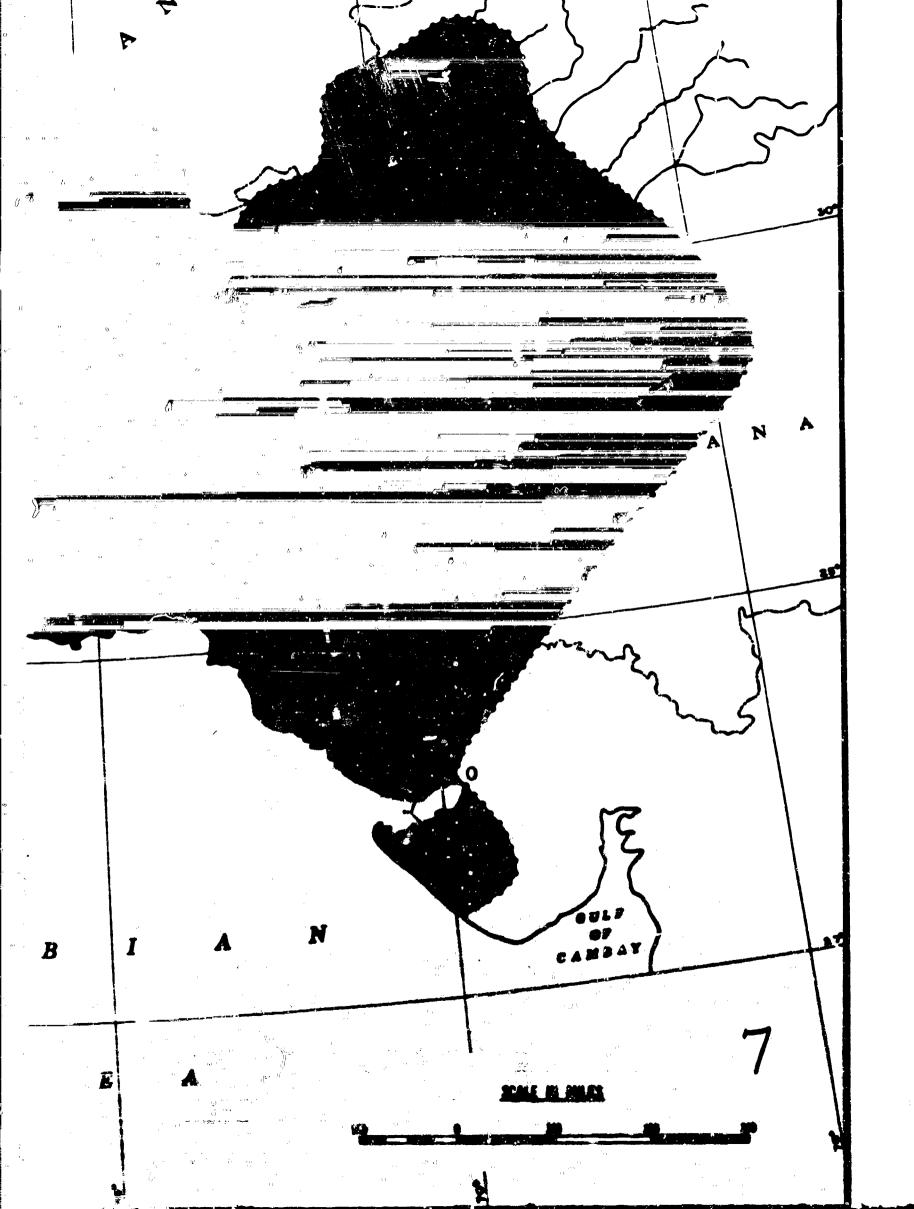
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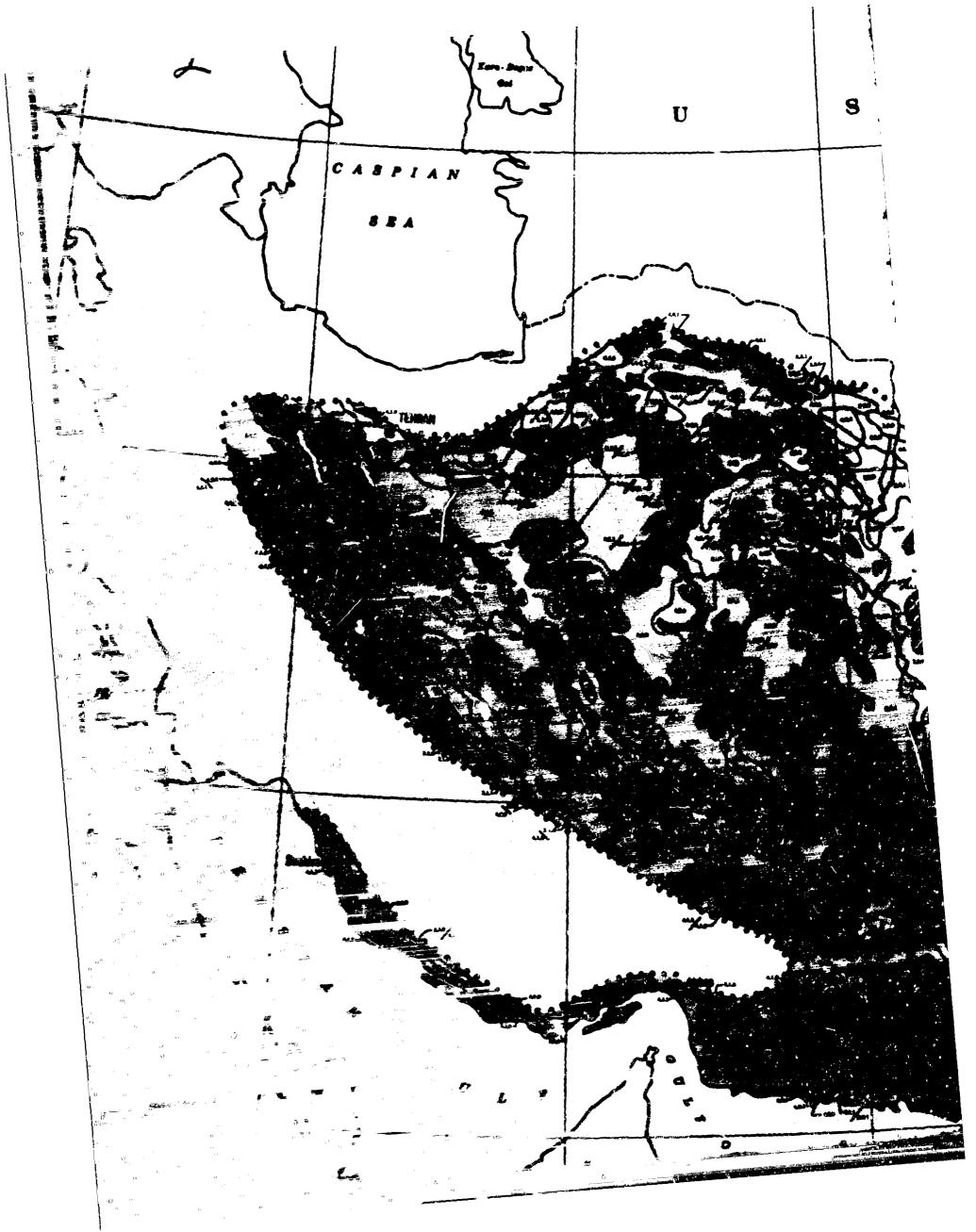
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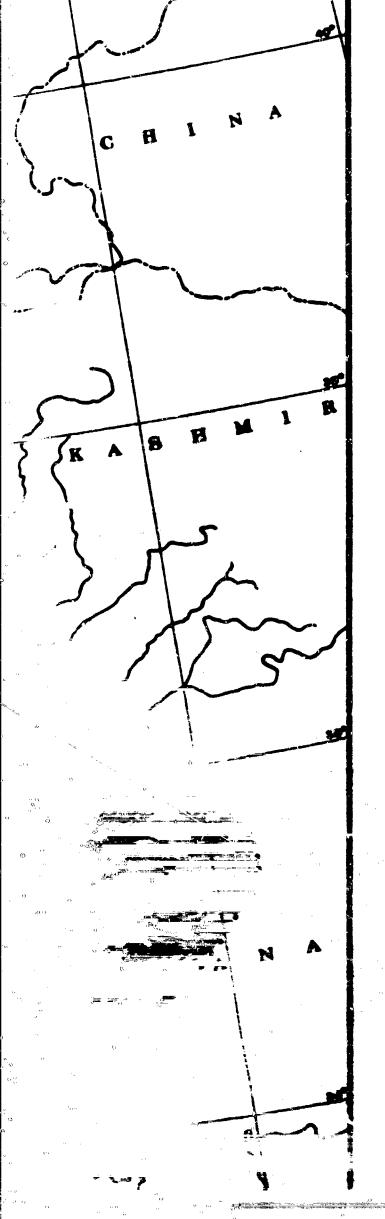
SOUTH CENTRAL ASIAN DESIGN

TERRAIN - TYPE ANALOGE

PLANE 13







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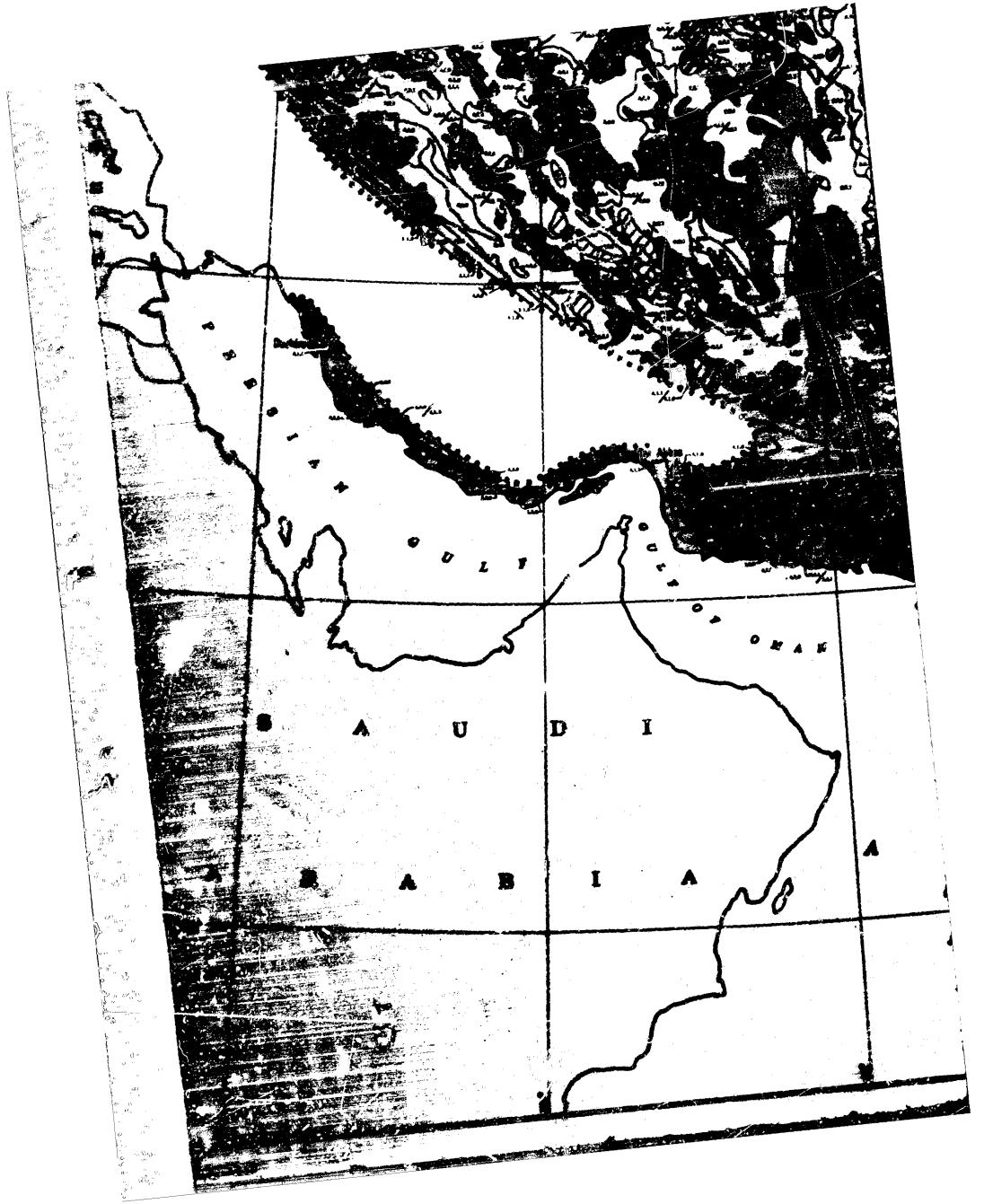
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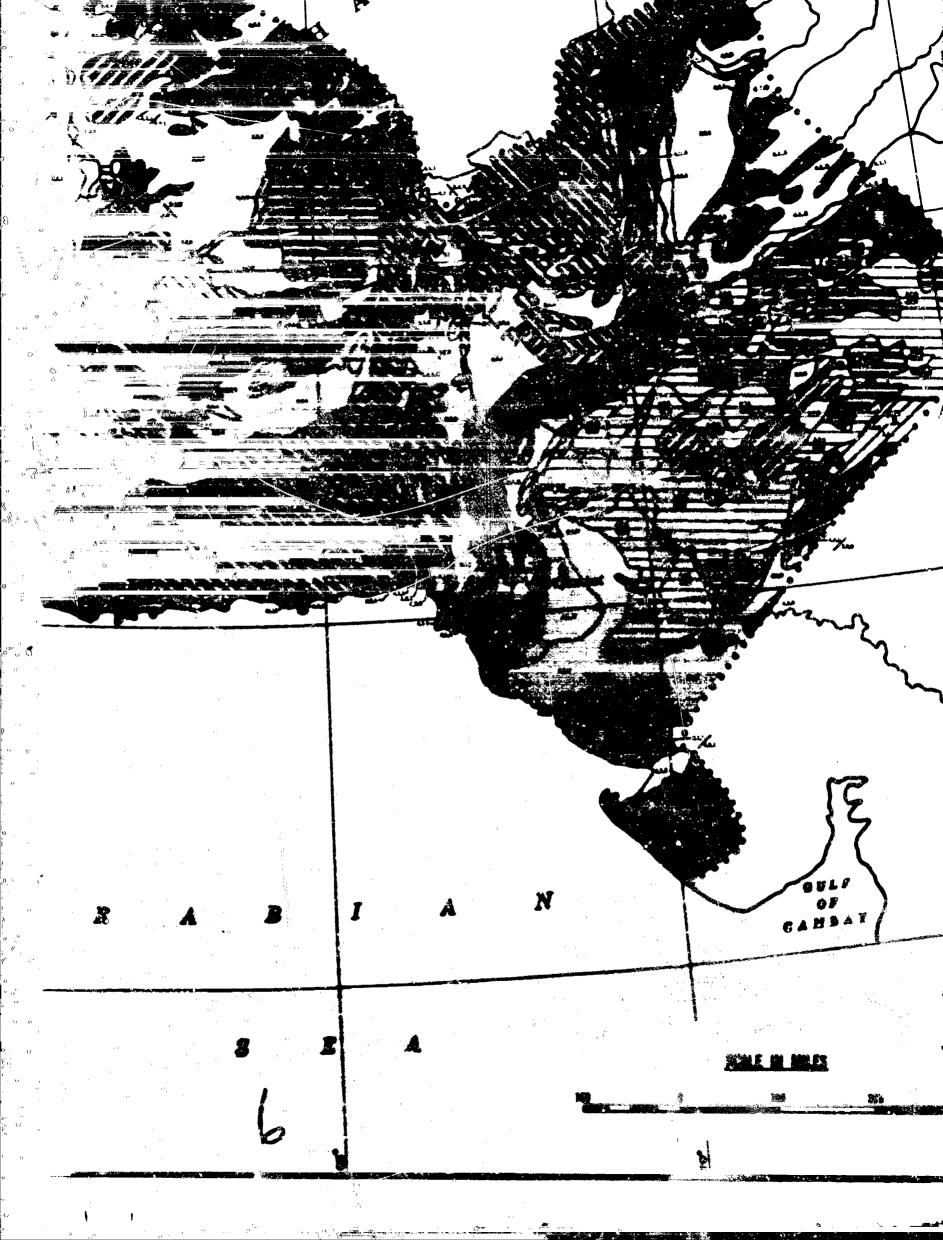
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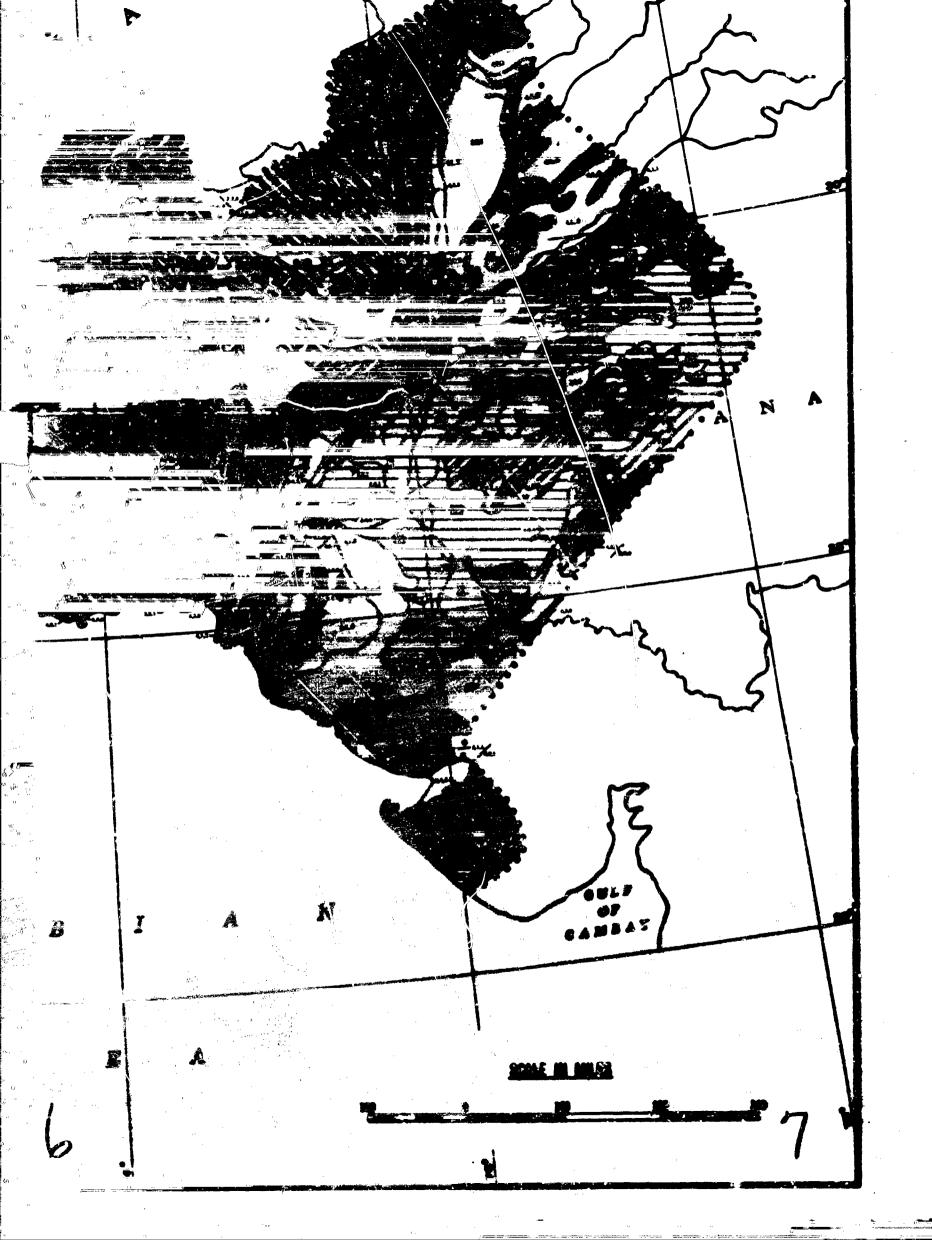
4.2.1 Areas delimented on the terroin-type erolog map are designated by three digits. There numbers are distremined by comparing the scretch type characterizing the area in South Control Aria with the most circular terrains type found at Tuna. The numbers indicate, in vagasses the number of identical geometry, ground, and vagatation factor often reques occurring in the South Control Arias terrain type that are found in combination at Tuna. Thus, the series 4.7.1 found in South Control Aria indicates that all sown terrain type that are found in seathfurthed for the discount factor characteristing on area in South Control Aria are found in devahisation at Tuna. (The attent service parties type area to determined the generating the generatory, greated, and vegetation number maps or the individual factor maps.) The cosins "1,1 indicates their, when comparing the South Control Arian service - a with the next circular type feeded at Tuna, two of the flux generator factor classes, and the vegetation since are found.

In adverting the recet establer terresh type found at Yunn it is, of course, other perceitle to find two or three types having the enses total negation of factor cleanes in common with the South Council Action type wither consideration. In this count, cohorten in theodor on the color in which the factors occur in the cories or array. For emergin, the South Control Anian terrain type 7,1,2,3 – 6,10 – 2 is engaged with the Yunn type 7,1,3 – 6,10 – 2 is engaged with the Yunn type 7,1,3 – 6,10 – 2 or type 1,1,2,3 – 6,10 – 2.

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ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT

SECTION II: SUPPLEMENTAL MAPS AND TABULATIONS

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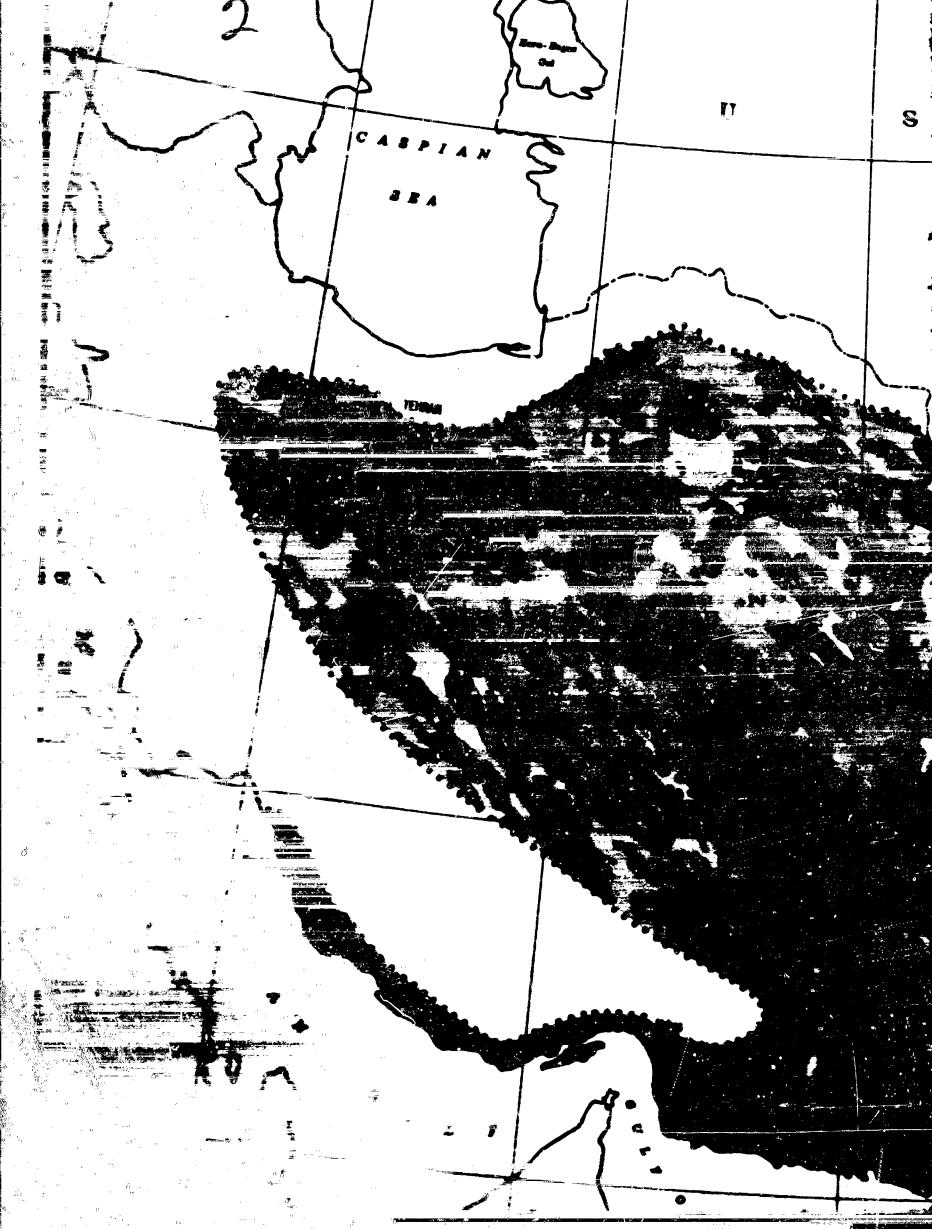
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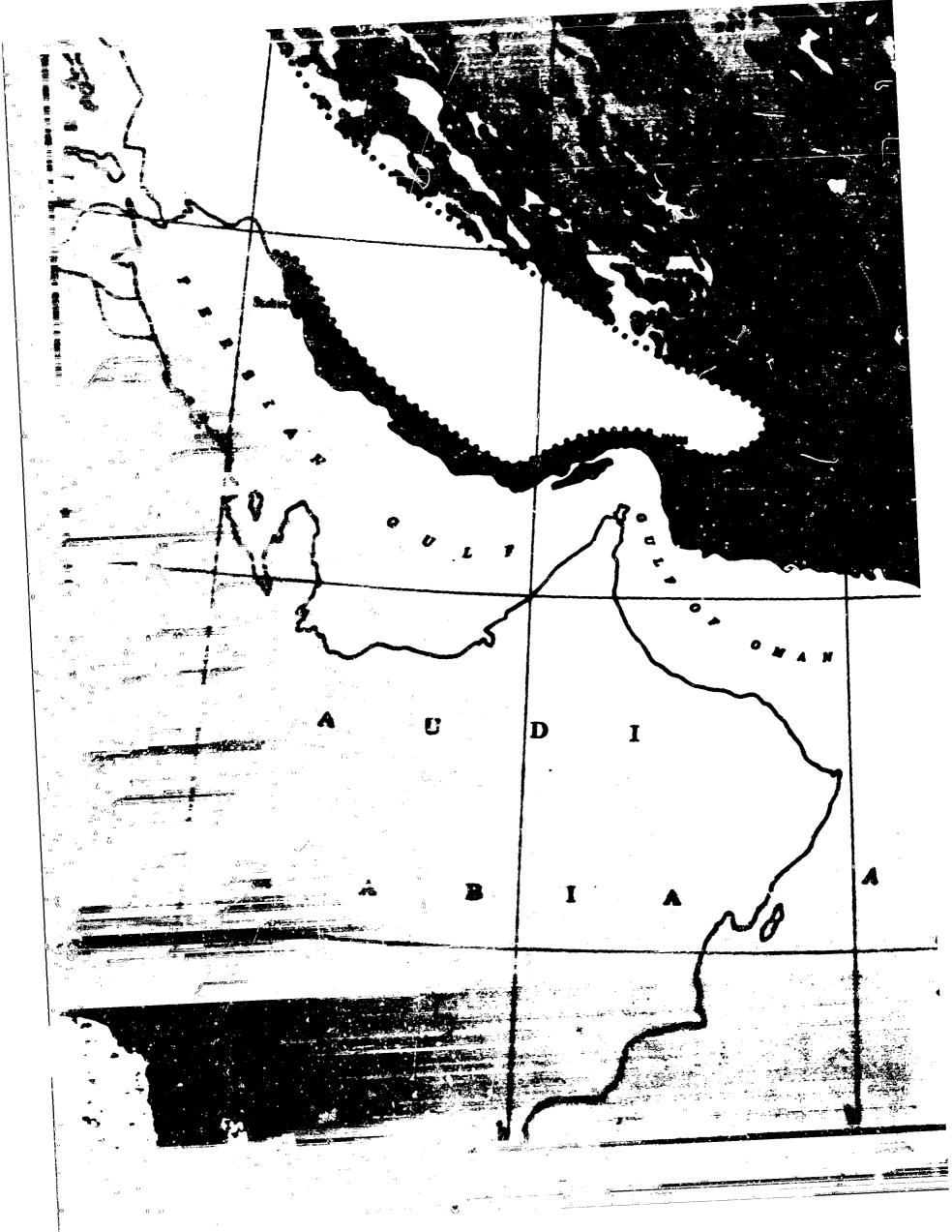
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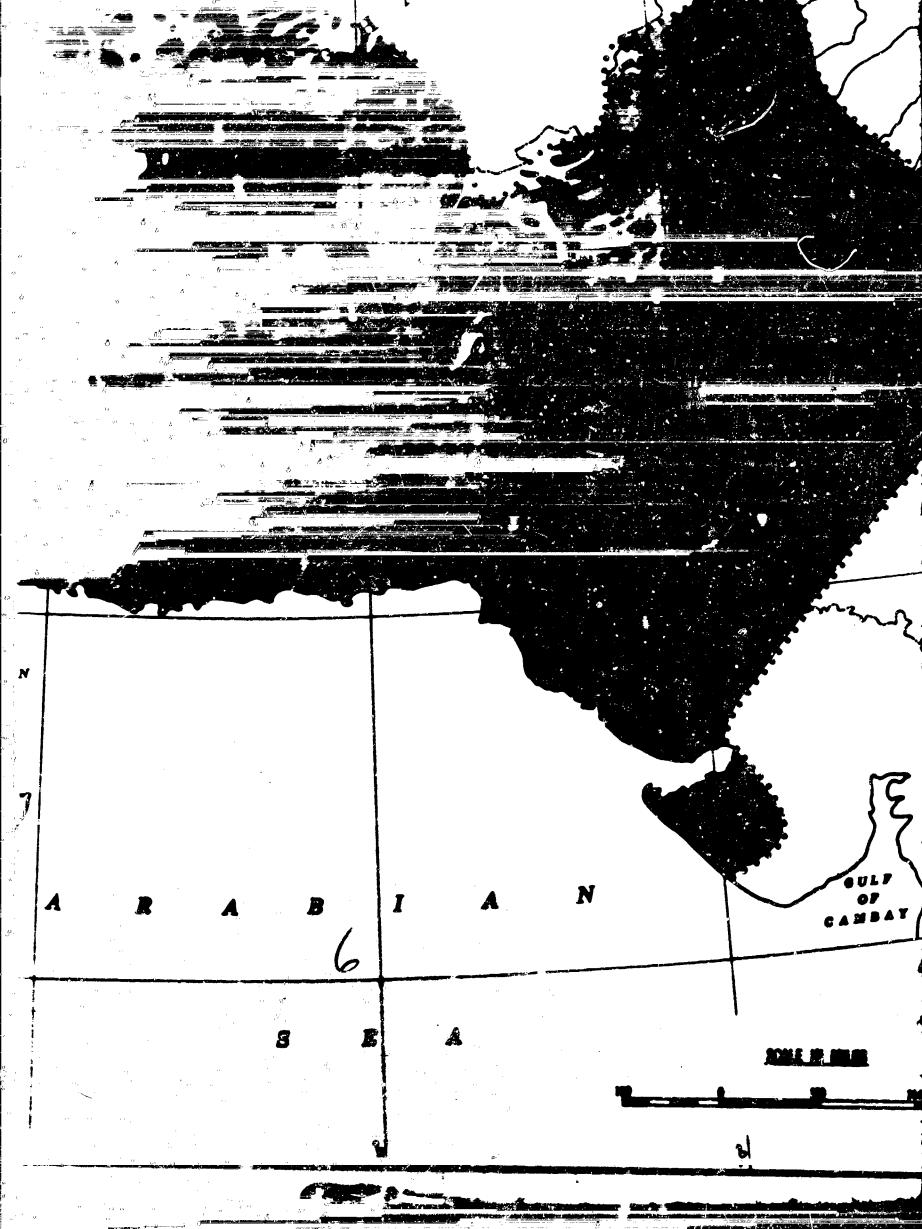


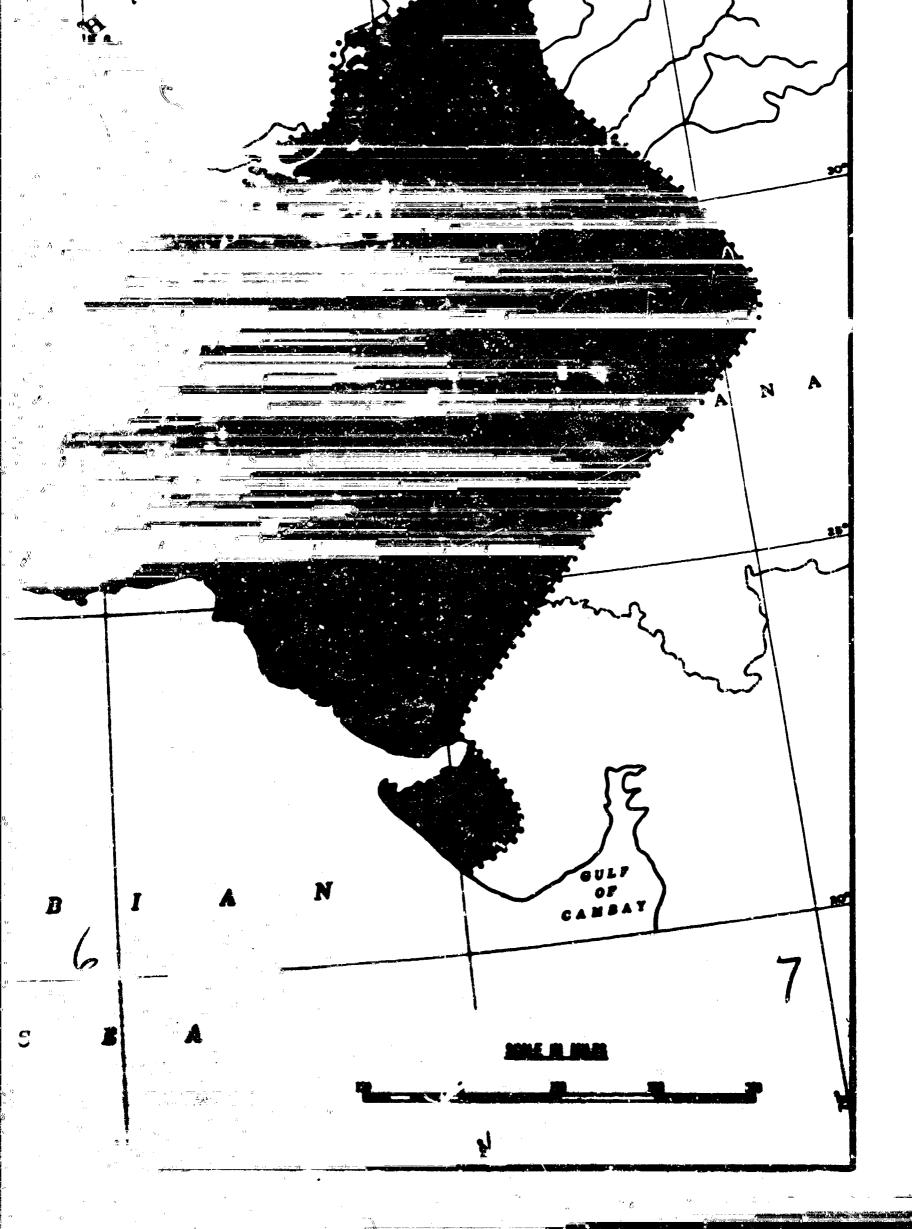


YUMA TEST STATION

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PER PARTY

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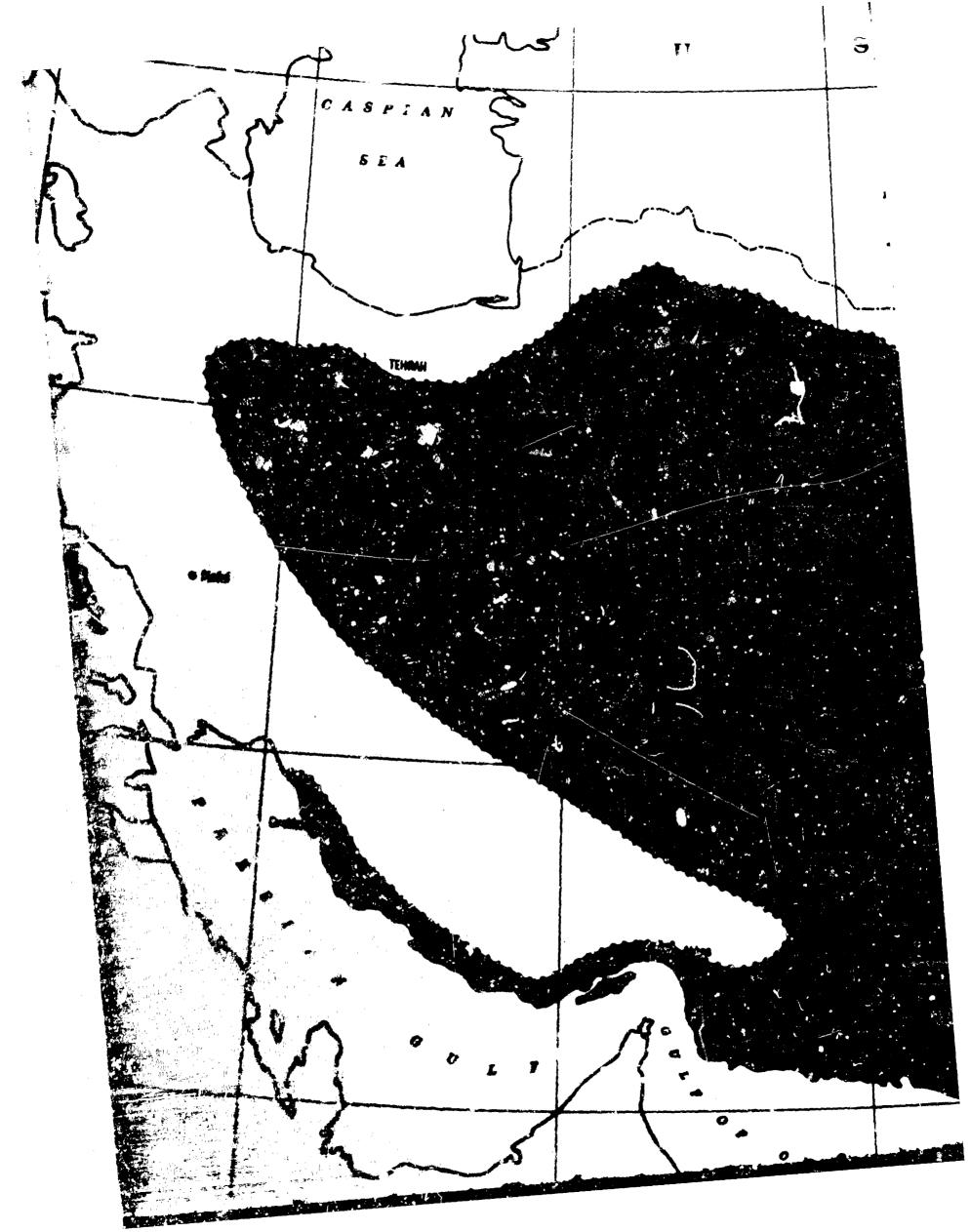
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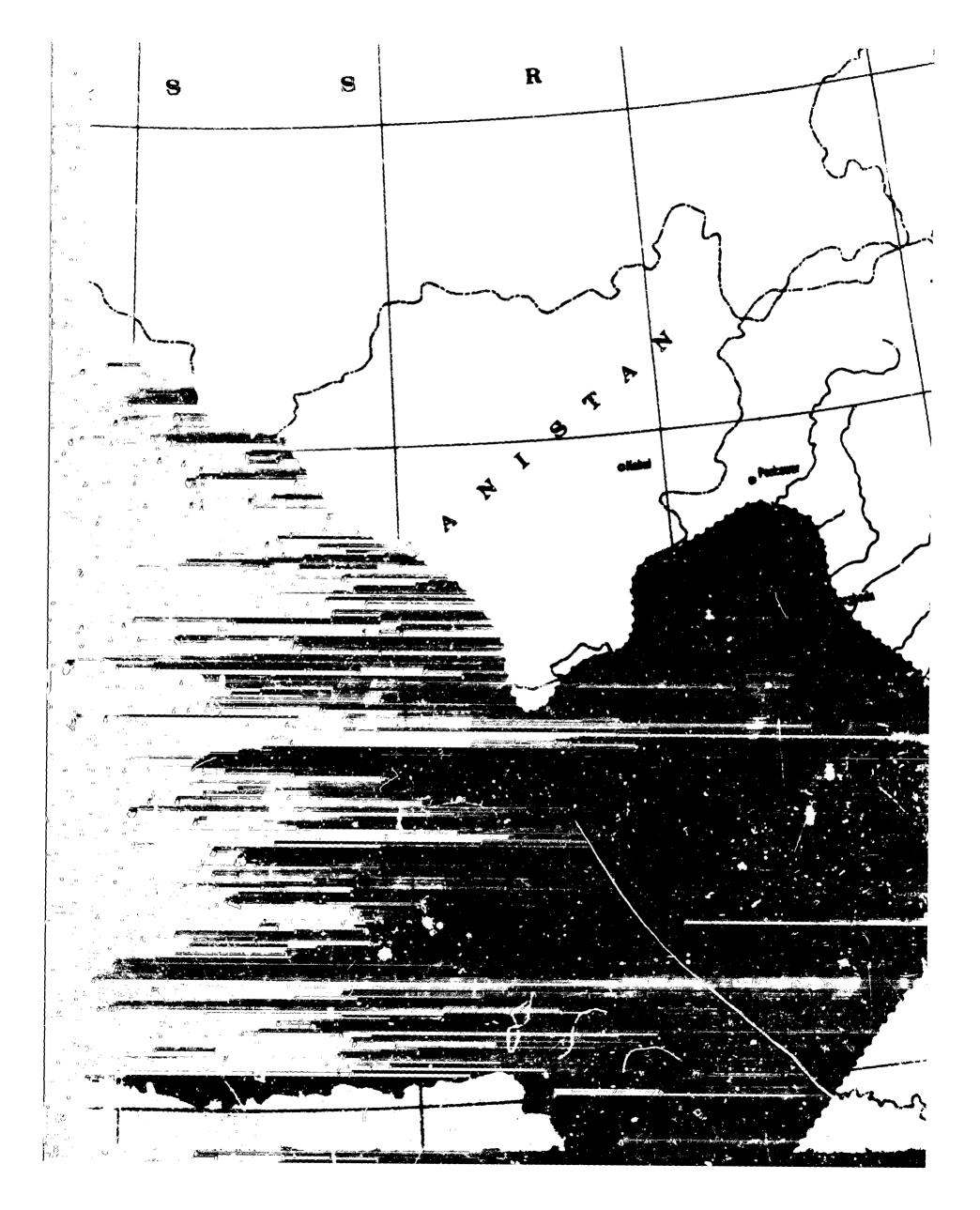
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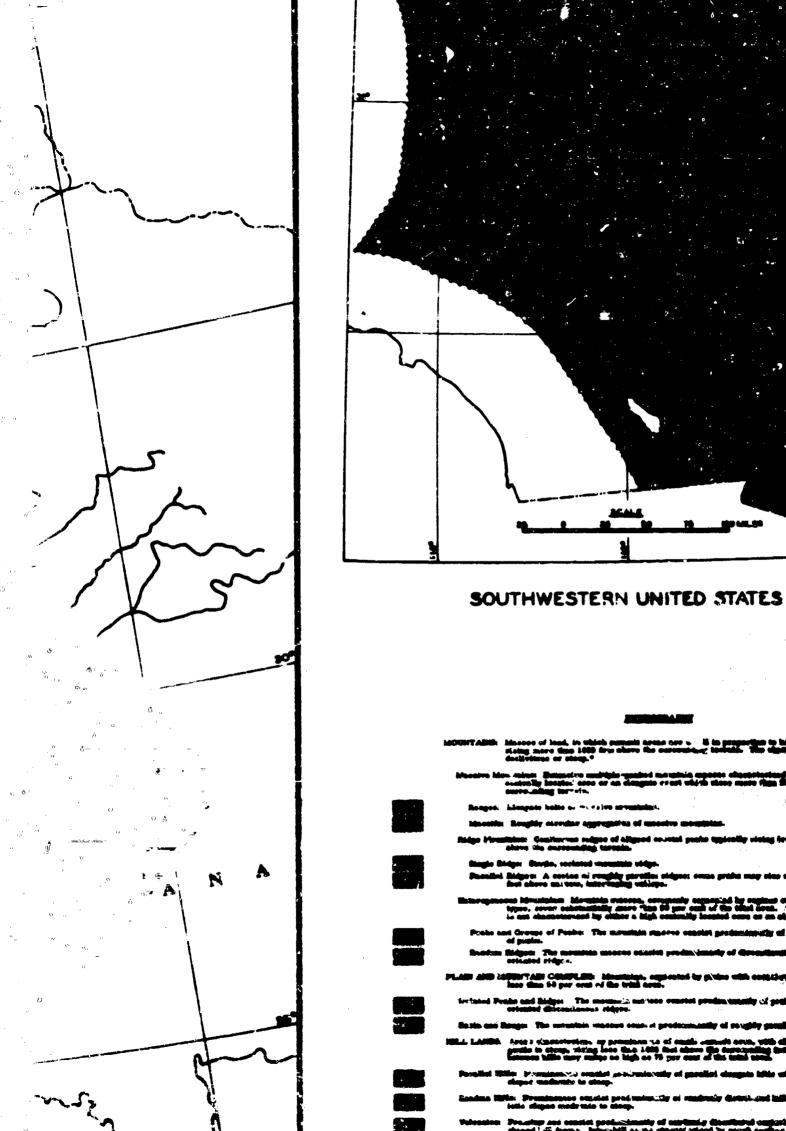
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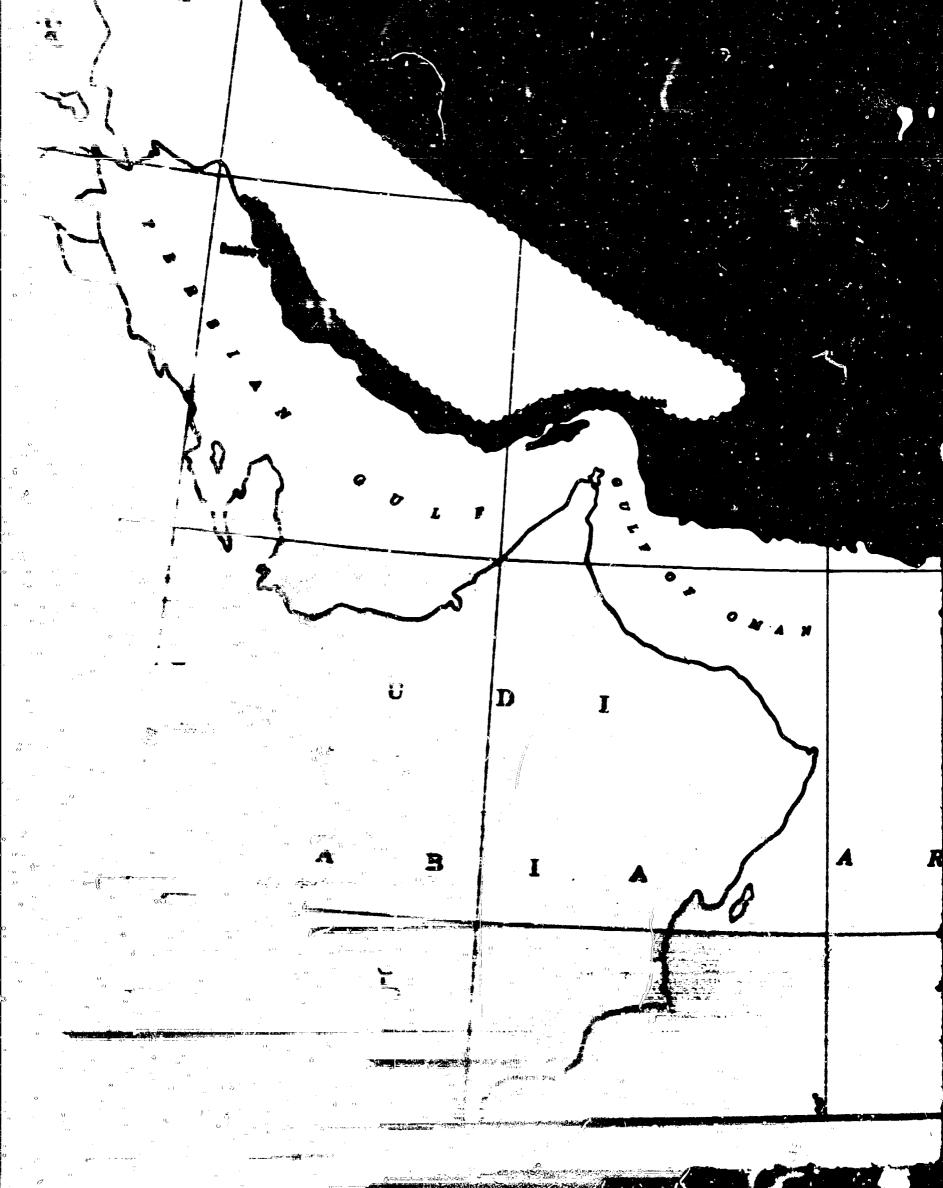
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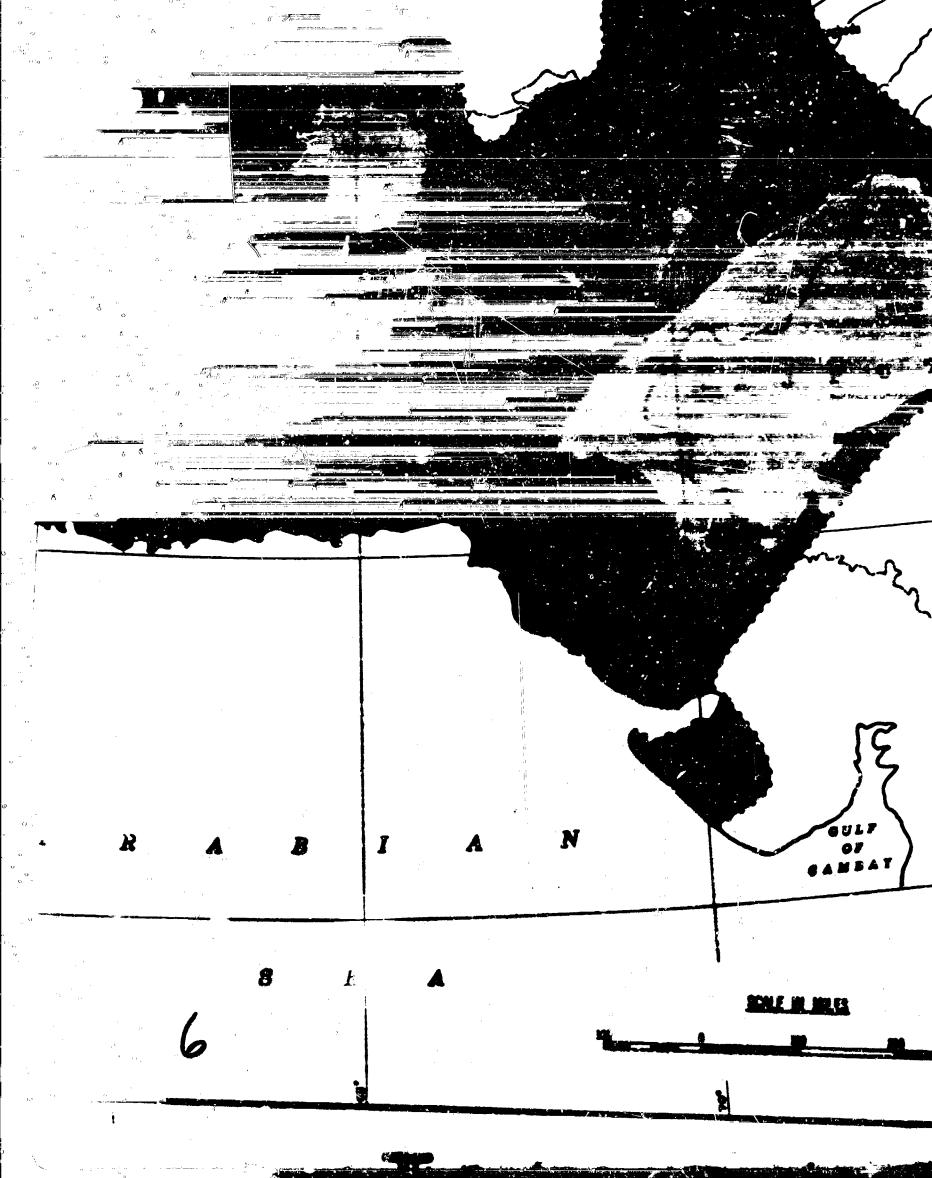
PHYSIOCRAPHY

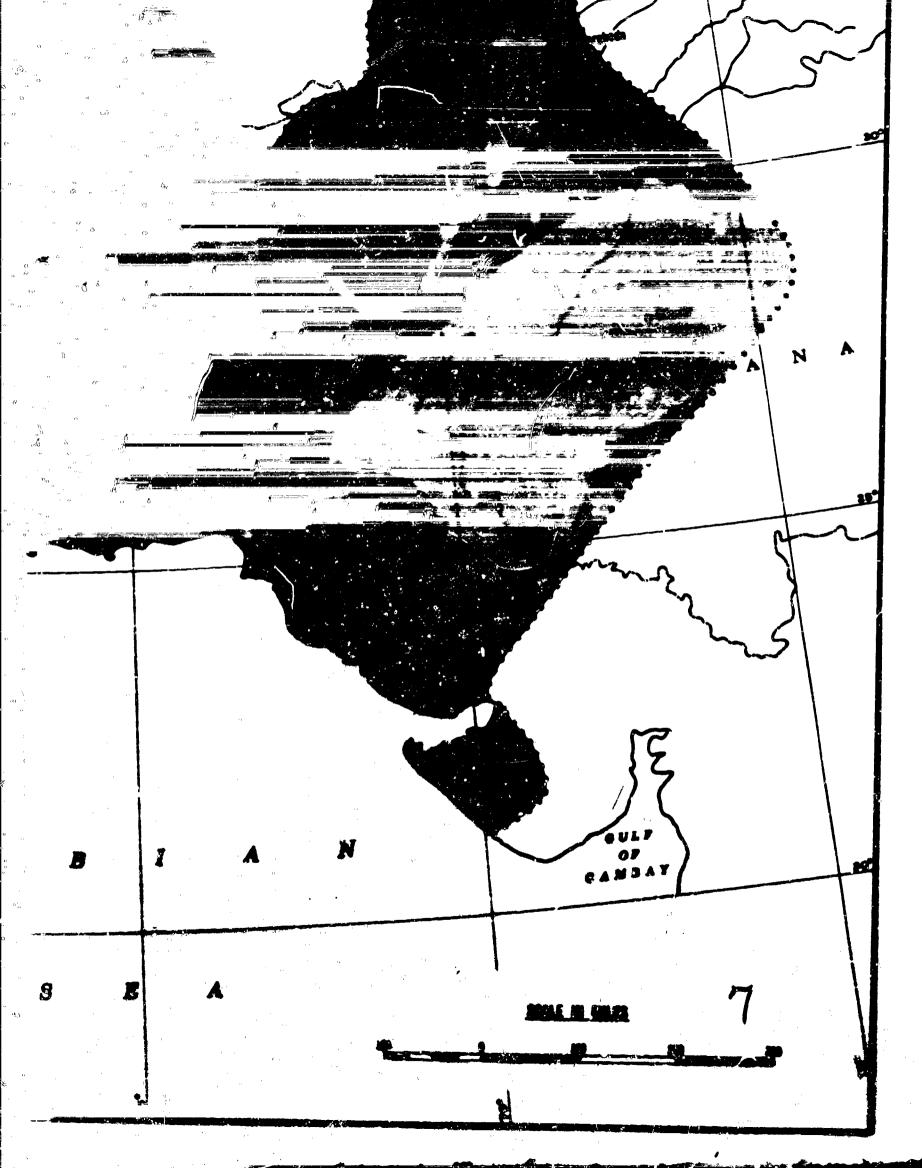












ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT

PHYSIOGRAPHY

DESCRIPTIONS AND PHOTOGRAPHS

PLATE 16

pared to basal dimensions. Areas so mapped may be entirely mountainous, such as massive, ridge, and plain-mountain complexes in which the plains occupy more than 50% of the total area. The South Central As 50% of it being mapped as mountains. Mountains flank the area on the north, west, and south. Several nor portion. The are for the most part continuous mountainous masses enclosing huge interior regions which is separated by oughly parallel, discontinuous mountain ranges. The mountains are characterized by bare designed from 50 to several thousand feet. They are composed chiefly of sedimentary and extrusive rocks but locally



M-1. Massive mountains north of Meshed. Picture shows a typical intramontane valley winding between the towering, rugged ranges characteristic of the area. At 37°20' N, 59° E



M-2. The southern Zagros Mountains along the Pers Gulf. No more rugged mountains than these, with the sharp pinnacles and spikes, are to be found in the ar At approximate¹, 28° N, 52° E





M-7. Photographs a, b, and c show the result of an earthquake that occurred in the vicinity of Quetta? Photograph a shows an escarpment caused by faulting near Mastung south of Quetta. The escarpment graph, the lightface contrasting with the dark surface of the ground. Photographs b and c show Mount before and after the earthquake. Photograph c shows the scars of the rock falls caused by the earthquake lines along the steep slopes of the mountain. Photograph a at 29045' N, 67050' E; b and c at 300 N, 67050' E; b
II. HILL LANDS: Hill lands are areas characterized by prominences of small summit area that rise to heights of less than 100 so mapped may consist entirely of hill masses or of nills separated by plains which may occupy as much as 7 and composition of hill lands vary widely. They may consist of parallel or random hills composed of igneous even unconsolidated materials; volcanic hills composed of lava or cinders; or sand dunes, sculptured into a weight within hill lands range from gentle to steep, and relief ranges from 10 to several hundred feet. The dunes, volcanic hills are characteristically barren whereas the random and parallel hills usually support a sparse year proximately 16% of the South Central Asian Desert.

The most widespread of the hill types are sand dunes. Dunes may be conveniently divided into two basic tyre, bilized or vegetated dunes. Stabilized forms occur in the northern part of the area in Alghanistan. The big quite arbitrary, being determined largely by the sporadic rainfall. In general, the terrain is cently indulated reaching heights of several hundred feet. Shallow drain, geways score the surface of introquent intervals, dense stand of vegetation.

Mobile dune types are found throughout the entire area. Where not a mally mapped, the covering small types.

Al Asian Desert is very mountainous, more than all north-south ranges trend through the central with are, in turn, subidvided into smaller basins e, declivitous to steep slopes and relief ranging acally of granites and metamorphic rocks.



or Persian with their the area.



M-3. Elongate dome flanked by hogback ridges in the Zagros Mountains along the Persian Gulf. These features occur frequently throughout the area. At 27°30' N, 52°30' E



M-4. Steep wadi banks near Isfahan. The sides are precipitous to steep. Mapped extensively in the basin and range region. At 32945' N, 51940' E



M-5. Alluvial Tehran. Photo braided draines characteristic out the entire.



Quetta in the Sulaiman Mountains of Pakistan.

pment trends through the middle of the photoMount Chiltan between Mastung and Quetta
arthquake. The scars are the light-colored
N, 67050' E



M-8. Schuppen at Suriab in the Makran Mountains in southern Iran. Hill-like in form, they occur in elongate belts and result from the differential erosion of resistent sandstone and soft shale. At 270 N, 57030' E



M-9. Badlands near Bandini is southern Makran region. They the result of severe erosion in sedimentaries. At 25035' N, 59030' E

han 1000 ft above the surrounding terrain. Areas ich as 75% of the total area. The characteristics gneous, metamorphic, and sedimentary rock or ito a wide variety of shapes by the wind. Slopes liunes, except for vegetated dune areas, and the barse vegetative cover. Hill lands comprise ap-

The boundaries of the vegetated dune areas are all thing to rolling with crests of stabilized dunes also, and their beds are often covered by a fairly

call isolated patches within other physiographic





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N, 51°40' E



M-f. Alluvial fans near Rey, southeast of Tehran. Photograph shows the characteristic braided drainage pattern. Fans and aprons are characteristic of hills and mountains throughout the entire area. At 32°35' N, 51°25' E



M-6. High rugged mountains and steep intramontane valleys near Chin in the western Zagros. The mountain in the left foreground rises 3000 ft above the valley. At approximately 31° N, 50°50' E



M-9. Badlands near Bandini in the southern Makran region. They are the result of severe erosion in soft sedimentaries. At 25°35' N, 59°30' E

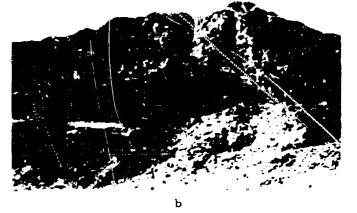


M-10. Badlands east of Bir in the southern Makran. Badlands such as these would be almost impossible to negotiate. At approximately 25030' N, 59050' E



M-11. Kuh-i-Nan.ak south of Bushire in the Zagros Mountains. The drawing shows the broad salt dome with a salt glacier measuring 1-1/2 miles in width flowing down the northwestern flank. This is one of some 150 known domes in the southern Zagros Mountains. At 28045' N, 52040' E





M-7. Photographs a, b, and c show the result of an earthquake that occurred in the vicinity of Que Photograph a shows an escarpment caused by faulting near Mastung south of Quetta. The escarpm graph, the lightface contrasting with the dark surface of the ground. Photographs b and c show Mo before and after the earthquake. Photograph c shows the scars of the rock falls caused by the ear! lines along the steep slopes of the mountain. Photograph a at 29045' N, 67050' E; b and c at 300 N

II. HILL LANDS: Hill lands are areas characterized by prominences of small summit area that rise to heights of less than so mapped may consist entirely of hill masses or of hills separated by plains which may occupy as much and composition of hill lands vary widely. They may consist of parallel or random hills composed of igne even unconsolidated materials; volcanic hills composed of lava or cinders; or sand dunes, sculptured into within hill lands range from gentle to steep, and relief ranges from 10 to several hundred feet. The dun volcanic hills are characteristically barren whereas the random and parallel hills usually support a spare proximately 16% of the South Central Asian Desert.

> The most widespread of the hill types are sand dunes. Dunes may be conveniently divided into two basic t bilized or vegetated dunes. Stabilized forms occur in the northern part of the area in Afghanistan. The quite arbitrary, being determined largely by the sporadic rainfall. In general, the terrain is gently undula reaching heights of several hundred feet. Shallow drainageways score the surface at infrequent intervals. dense stand of vegetation.

> Mobile dune types are found throughout the entire area. Where not actually mapped, they occur in small types.



H-1. Complex dunes of the Lut in southern Iran. The Lut is described as a confused, closely spaced mass of dunes with no apparent orientation but, rather, combinations of basic dune types. It is one of the most difficult dune areas in the world to negotiate. At 30°30' N, 59°40' E



H-2. Yardangs of the southern I wind-eroded silt deposits occurin roughly parallel bands separat flat troughs. Heights vary from to 200 ft. Movement paralled to t is unimpeded but transverse more impossible. At 300 N, 59015' 11'







that occurred in the vicinity of Quetta in the Sulaiman Mountains of Pakistan, stung south of Quetta. The escarpment trends through the middle of the photogonal. Photographs b and c show Mount Chiltan between Mastung and Quetta of the rock falls caused by the earthquake. The scars are the light-colored 129045' N, 67050' E; b and c at 300 N, 67050' E



M-8. Schuppen at Surtab in the Makran Mountains in southern Iran. Hill-like in form, they occur in elongate belts and result from the differential erosion of resistent sandstone and soft shale. At 270 N, 57930° E.

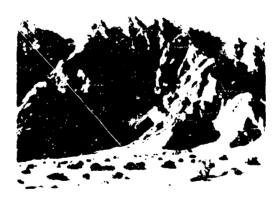
brea that rise to heights of less than 1000 ft above the surrounding terrain. Areas by plains which may occupy as much as 75% of the total area. The characteristics led or random hills composed of igneous, metamorphic, and sedimentary rock or lders; or sand dunes, sculptured into a wide variety of shapes by the will. Slopes to several hundred feet. The dunes, except for vegetated dune areas, and the parallel hills usually support a sparse vegetative cover. Hill lands comprise ap-

conveniently divided into two basic types: (i) mobile or active dunes and (2) stabart of the area in Afghanistan. The boundaries of the vegetated dune areas are general, the terrain is gently undulating to rolling with crests of stabilized dunes the surface at infrequent intervals, and their beds are often covered by a fairly

ctually mapped, they occur in small isolated patches within other physiographic



H-2. Yardangs of the southern Lut. These wind-eroded silt deposits occur as low hills in roughly parallel bands separated by wide, flat troughs. Heights vary from several feet to 200 ft. Movement paralled to the yardangs is unimpeded but transverse movement is impossible. At 300 N, 59015' E



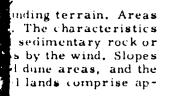
H-3. Severely eroded igneous hills south of Sargodha in the Punjab. These inselbergs or ridges may rise to heights as great as several hundred feet above the alluvial plain. They occur chiefly between Sargodha and Chenab. At 320 N, 72°40° E.



H-4. Granite hills no Rajputana. The hills of trusion of an igneous dation. They are char sided and may attain thundred feet. At appropriate 13°35' E



ntains of Pakistan, middle of the photostung and Quetta the light-colored



ive dunes and (2) statated dune areas are ts of stabilized dunes in covered by a fairly

cother physiographic



H-3. Severely eroded igneous hills south of Sargodha in the Punjab. These inselbergs or ridges may rise to heights as great as several hundred feet above the alluvial plain. They occur chiefly between Sargodha and Chenab. At 32° N, 72°40° E



M-8. Schuppen at Surtab in the Makran Mountains in southern fran. Hill-like in form, they occur in elongate belts and result from the differential erosion of resistent sandstone and soft shale. At 270 N, 57030' E



M-9. Badlands near Bandini in the southern Makraii region. They are the result of severe crosion in soft sedimentaries. At 25°35' N, 59°30' E



M-10. Badland southern Makra as these would sible to negotial mately 25°30°3



H-4. Granite hills near Desuri in western Rajputana. The hills were formed by the intrusion of an igneous mass followed by denudation. They are characteristically smooth-sided and may attain heights of several hundred feet. At approximately 25°15' N, 73°35' E



H-5. Bouldery surfactivial fan at the base of Range north of Jhe, or Punjab, Movement the boulderly plains is diff 33° N, 75°30° E.



lands near Bandini in the Jakran region. They are of severe erosion in soft ries. At 25°35' N.



M-10. Badlands east of Bir in the southern Makran. Badlands such as these would be almost impossible to negotiate. At approximately 25°30' N, 59°50' E



M-11. Kuh-i-Namak south of Bushire in the Zagros Mountains. The drawing shows the broad salt dome with a salt glacier measuring 1-1/2 miles in width flowing down the northwestern flank. This is one of some 150 known domes in the southern Zagros Mountains. At 28045' N, 52040' E





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25°15' N.



M-5. Bouldery surface of an alluvial fan at the base of the Salt Range north of Jhelum in the Punjab. Movement through these boulderly plains is difficult. At 33° N, 73° 30° E



H-6. Mud volcano in the Makran Mountains. The volcances are formed by the eruption of sulfurous and bituminous mud from a central vent. At 25°30' N, 59°55' E

ANALOGS OF YUMA TERRAIN
IN THE

SOUTH CENTRAL ASIAN DESERT

PHYSIOGRAPHY

DESCRIPTIONS AND PHOTOGRAPHS

ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT

PHYSIOGRAPHY

DESCRIPTIONS AND PHOTOGRAPHS

PHYSIOGRAP

III. PLATEAUS: Plateaus are elevated masses of land Characterized by extensive, more or less that lying summat are estimated greater than 100 ft in height. Dissected plateaus have been mapped where less than 85% of the original so South Central Asian Desert is mapped as plateau. None of the South Central Asian plateaus are dissected plateau summit is usually less than 1 degree; however, some summits have surfaces which are more unduluded to 6 degrees. Relief on the flat-lying summits may range up to 10 ft, whereas the rolling plateau tops has

dissection along the major drainageways may occasionally exceed 1000 ft. The prateaus of South Central Astract rocks capped by layers of volcanic rock. In general, summit elevations lie between 0 and 1000 ft.

IV. PLAINS: Plains are extensive tracts of land characterized by flat to gentle slopes. Hills may be found within these traces. Plains occupy approximately 25% of the South Central Asian Desert and may be subdivided on the basis of plains, deltas, and terraces of major rivers are termed alluvial plains; plains bordering the sea, coastal plain usually bounded on two or more sides by scarps, depression plains; and interior plains not readily classifiable in sected plains exhibit relief ranging from 0 to approximately 10 ft. Relief within dissected plains is characterist ally up to 100 ft. The soil and rock types associated with the plains of South Central Asia vary widely. Most of 2000 ft; however, smaller ones are found between 2000 and 3000 ft.

More than 9% of the South Central Asian plains have been mapped as desert plains. Although this figure may so term "desert plain" as used here embraces a variety of types. Included in this classification are: the great intin some cases, but sometimes dissected to an extent that would seriously impede cross-country movement, we mountains; the salt plains occurring in the great arid basin of Iran range in size from several to thousands of these plains are composed of a thick crust of salt underlain by mire. Exposed to the intense heat of the sun, the often rendering it impossible to traverse; the great sandy plains, swept by the wind, and with their monotony in common in the interior of the study area; and the featureless expanses of bare rock, their surfaces denuded by desert plain. Chances of survival in such plains would be minute due to the lack of both water and vegetative cover.

The coastal plains of South Central Asia occur as discontinuous areas of varying width which extend from Bushi Kathiwar Peninsula, their continuity being broken occasionally by rugged mountains extending to the sea.

Alluvial plains occupy a significant portion of the study area. The Indus River, from its entrance into the area Arabian Sea, is bordered by a wide, flat floodplain. The Punjab, land of five rivers, is another large alluvial tract

The depression plains are relatively small in area, but are of physiographic interest. These depressions usually esolution, and/or faulting. The depression plains of South Central Asian Desert worthy of mention are the Seistan B boundaries of Iran, Pakistan, and Afghanistan, and the Jaz Murian Basin in southwest Iran north of the Makran being are flat, with relief ranging from several to tens of feet. Scarps bordering the plains commonly range from characteristic of depressions include: alluvial fans, low dunes, scarps, amphitheaters, salt-encrusted playas, tall



19-1. Desert plain in western Rajputana showing typical vegetation. The loose sandy soil is called retli. The trees in the right foreground and seen scattered throughout the background are known as kedhra. Vegetation in these areas seldom reaches a density that would seriously impede cross-country movement. At approximately 25° N, 72° E



P-2. Floodplain of the Indus Riverpatches are irrigated areas. The with dark spots are sandy areas, low dunes which form the transits the floodplain and the Than Describest. At approximately 200301 N.



PHYSIOGRAPHY: DESCRIPTION

hasses of land characterized by extensive, more or less flat-lying summit areas bounded on one or more sides by scarps hight. Dissected plateaus have been mapped where less than 85% of the original surface remains. Approximately 1% of the cert is mapped as plateau. None of the South Central Asian plateaus are dissected plateaus. The characteristic slope of the sy less than I degree; however, some summits have surfaces which are more undulating or rolling and exhibit slopes ranging from the flat-lying summits may range up to 10 ft, whereas the rolling plateau tops have relief ranging from 10 to 50 ft. Depth of or drainageways may occasionally exceed 1000 ft. The plateaus of South Central Asia occur in an area of flat-lying sedimenters of volcanic rock. In general, summit elevations lie between 0 and 1000 ft.

of land characterized by flat to gentle slopes. Hills may be found within these tracts but occupy less than 25% of the total kimately 25% of the South Central Asian Desert and may be subdivided on the basis of origin or physiographic relation. Floods of major rivers are termed alluvial plains; plains bordering the sea, coastal plains; low-lying plains of interior drainage fore sides by scarps, depression plains; and interior plains not readily classifiable into the other types, desert plains. Undistraigning from 0 to approximately 10 ft. Relief within dissected plains is characteristically between 10 and 50 ft and occasion and rock types associated with the plains of South Central Asia vary widely. Most of the plains lie between elevations of 0 and ness are found between 2000 and 3000 ft.

Central Asian plains have been mapped as desert plains. Although this figure may seem high it should be understood that the definition are: the great intermontane plains, relatively undissected best dissected to an extent that would seriously impede cross-country movement, which separate the discontinuous ranges of a curring in the great arid basin of Iran range in size from several to thousands of square miles in extent. The surfaces of a thick crust of salt underlain by mire. Exposed to the intense heat of the sun, the surface cracks into large blocks of salt, to traverse; the great sandy plains, swept by the wind, and with their monotony interrupted only by occasional dunes, are he study area; and the featureless expanses of bare rock, their surfaces denuded by the wind, represent still another type of rvival in such plains would be minute due to the lack of both water and vegetative cover.

Central Asia occur as discontinuous areas of varying width which extend from Bushire at the head of the Persian Guif to the ontinuity being broken occasionally by rugged mountains extending to the sea.

gnificant portion of the study area. The Indus River, from its entrance into the area in Northern Pakistan to its mouth at the a wide, flat floodplain. The Punjab, land of five rivers, is another large alluvial tract.

elatively small in area, but are of physiographic interest. These depressions usually originate through the process of erosion, ne depression plains of South Central Asian Desert worthy of mention are the Seistan Basin which hes just north of the common in, and Afghanistan, and the Jaz Murian Basin in southwest Iran north of the Makran Mountains. The floors of all the depressinging from several to tens of feet. Scarps bordering the plains commonly range from 100 to several thousand feet. Landforms is include: alluvial fans, low dunes, scarps, amphithenters, salt-encrusted playas, talus slopes, salt lakes, and salt marshes.



rn Rujputana showing typical by soil is called <u>retli</u>. The hd and seen scattered throughwn as <u>kedhra</u>. Vegetation in a density that would serily movement. At approximately



P-2. Floodplain of the Indus River. Dark patches are irrigated areas. The light areas with dark spots are sandy areas of plains and low dunes which form the transition between the floodplain and the Thar Desert to the east. At approximately 26°30° N, 67°50° E



P-3. Allignations of the practice of the pract



ally up to 100 ft. The goal and rock types associated with the plains of South Central Asia vary widely. Most of the claims 2000 ft; however, smaller ones are found between 2000 and 3000 ft.

More than 9% of the South Central Asian plains have been mapped as desert plains. Although this figure may seem aging the term "desert plain" as used here embraces a variety of types. Included in this classification are: the great intermentation in some cases, but sometimes dissected to an eltent that would seriously impede cross-country movement, which set at the mountains; the salt plains occurring in the great and basin of Iran range in size from several to thousands of square methods the plains are composed of a thick crust of salt underlain by mire. Exposed to the intense heat of the sun, the surface or often rendering it impossible to traverse; the great sandy plains, swept by the wind, and with their monotony interrupted occuming in the interior of the study area; and the featureless expanses of bare rock, their surfaces decided by the wind, in desert plain. Chances of survival in such plains would be minute due to the lack of both water and vegetative cover.

The coastal plains of South Central Asia occur as discontinuous areas of varying width which extend from Bushare at the net Kathiwar Peninsula, their continuity being broken occasionally by rugged mountains extending to the sea.

Alluvial plains occupy a significant portion of the study area. The Indus River, from its entrance into the area in Northern Arabian Sea, is bordered by a wide, flat floodplain. The Punjab, land of five rivers, is another large alluvial tract.

The depression plains are relatively small in area, but are of physiographic interest. These depressions usually originate thresolution, and/or faulting. The depression plains of South Cent all Asian Desert worthy of mention are the Seistan Basin which boundaries of Iran, Pakistan, and Afghanistan, and the Jaz Murian Basin in southwest Iran north of the Makran Mountains. I sions are flat, with relief ranging from several to tens of feet. Scarps bordering the plains commonly range from 100 to sever characteristic of depressions include: alluvial fans, low dunes, scarps, amphitheaters, salt-encrusted playas, talus slopes, a



P-1. Desert plain in western Rajputana showing typical vegetation. The loose sandy soil is called <u>retli</u>. The trees in the right foreground and seen scattered throughout the background are known as <u>kedhra</u>. Vegetation in these areas seldom reaches a density that would seriously impede cross-country movement. At approximately 25° N, 72° E



P-2. Floodplain of the Indus River. Dark patenes are irrigated areas. The light areas with dark spots are sandy areas of plains and low dunes which form the transition between the floodplain and the Thar Desert to the east. At approximately 26°30' N, 67°50' E



P-6. The floodplain south of Sargodha. This flat alluvial plain of silty sand is extensively cultivated. The range of hills in the background is an erosional remnant of an igneous intrusive. At approximately 32° N, 72°45' E



P-7. Incised bed of the River Tirkha Lora in loessial deposits northwest of Sargodha. Note the floodplain along the river and the excellent terraces along the far side. At approximately 30°15' N, 67005' E.



P-8. Braided a in the Indus Rij colored areas ground are san which are comriver. At appr 26°15' N, 68° F

seem high it should be understood that the intermontane plants, relatively undissected which separate the discontinuous ranges of efficient miles in extent. The surfaces of the surface cracks into large blocks of salt, interrupted only by occasional dunes, are by the wind, represent still another type of piver.

ishire at the head of the Persian Gulf to the

rea in Northern Pakistan to its mouth at the

ally originate through the process of erosion, Lin Basin which lies just north of the common an Mountains. The floors of all the depresfrom 100 to several thousand feet. Landforms , taius slopes, salt lakes, and salt marshes.



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''N, 67°50' E



P-3. Alluvial plain south of Sargodha with scattered igneous hills. The plains between are practically undissected, and except for occasional canals in irrigated areas, offer no obstacles to movement. At 31°50' N, 72°40' E



P-9. Low, flat portion of the coastal plain southwest of Karachi. The light-colored patches are surfaces covered with dried salt. The dark areas are patches of salt-tolerant grasses. At approximately 24050' N, 66055' E



P-4. Desert plain and vegetated dune area no of Karachi. At approx 24°55' N, 67°10' E



P-10. Sabkha souti The sabkha is of th moist variety and i principally of sand proximately 24°50'



P-8. Braided stream topography in the Indus River. The light-colored areas in the left fore-ground are sandbar deposits which are common all along the river. At approximately 26°15' N, 68° E





P-4. Desert plain and small vegetated dune area northeast of Karachi. At approximately 24055' N, 67010' E



P-5. Braided stream deposits in the Hall River northwest of Karachi. The sand and gravel were deposited when the channel chose a new course. At approximately 250 N, 66055' E



P-10. Sabkha southwest of Karachi. The sabkha is of the salt-encrusted, moist variety and is composed principally of sandy silt. At approximately 24°50° N, 66°55° E



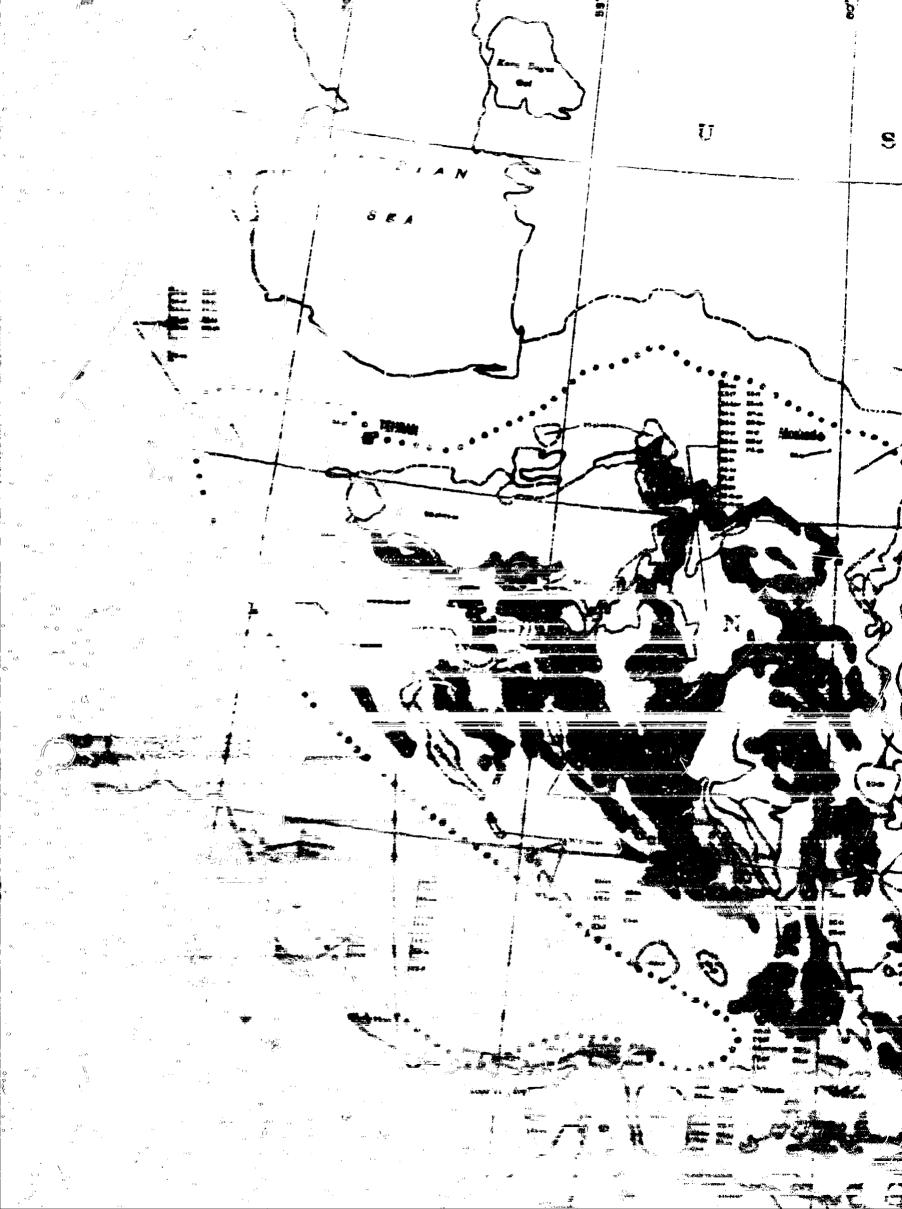
P-11. Low dunes along the coast east of Karachi. These dunes are commonly less than 50 ft high and are probably of the complex dune type. At approximately 24050' N, 67005' E.

he coastal plain

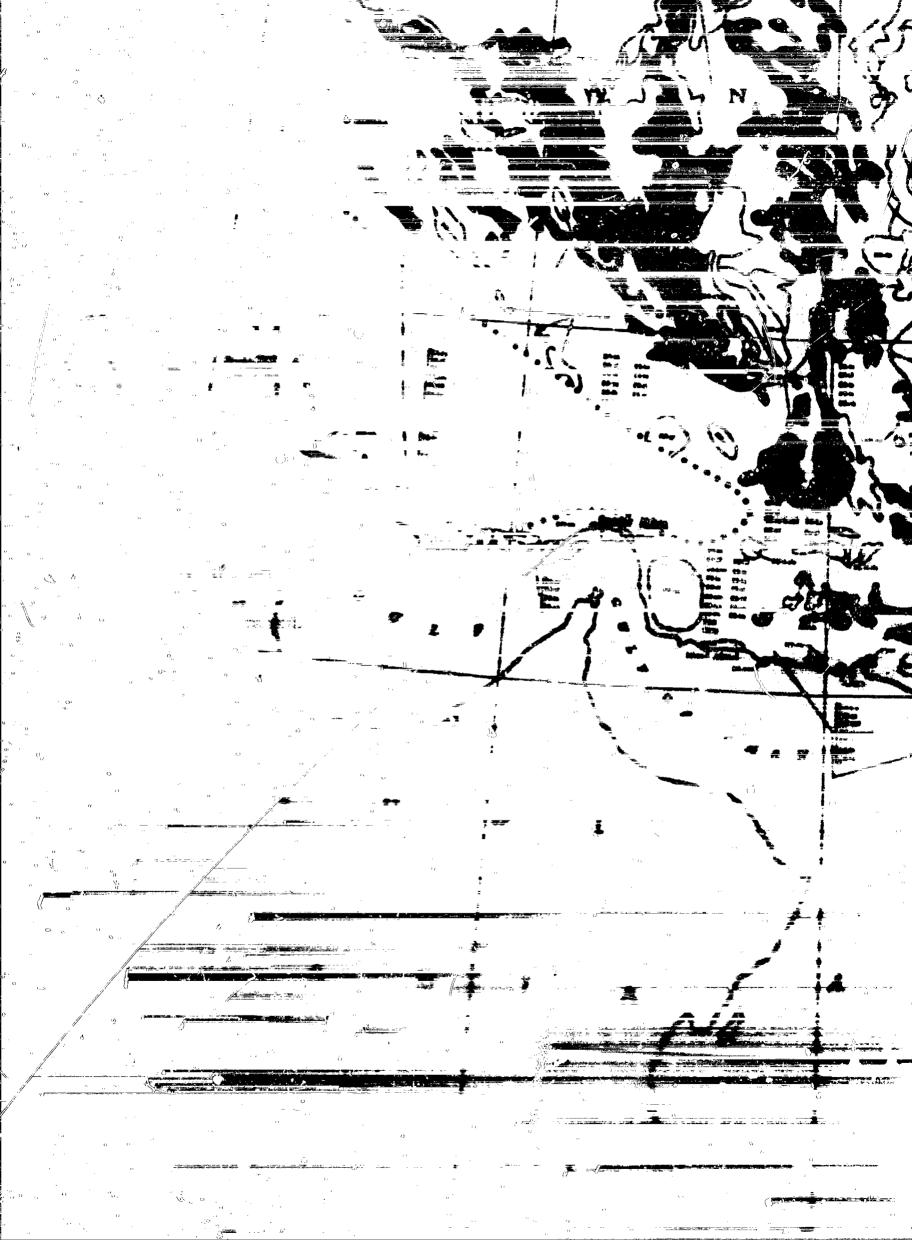
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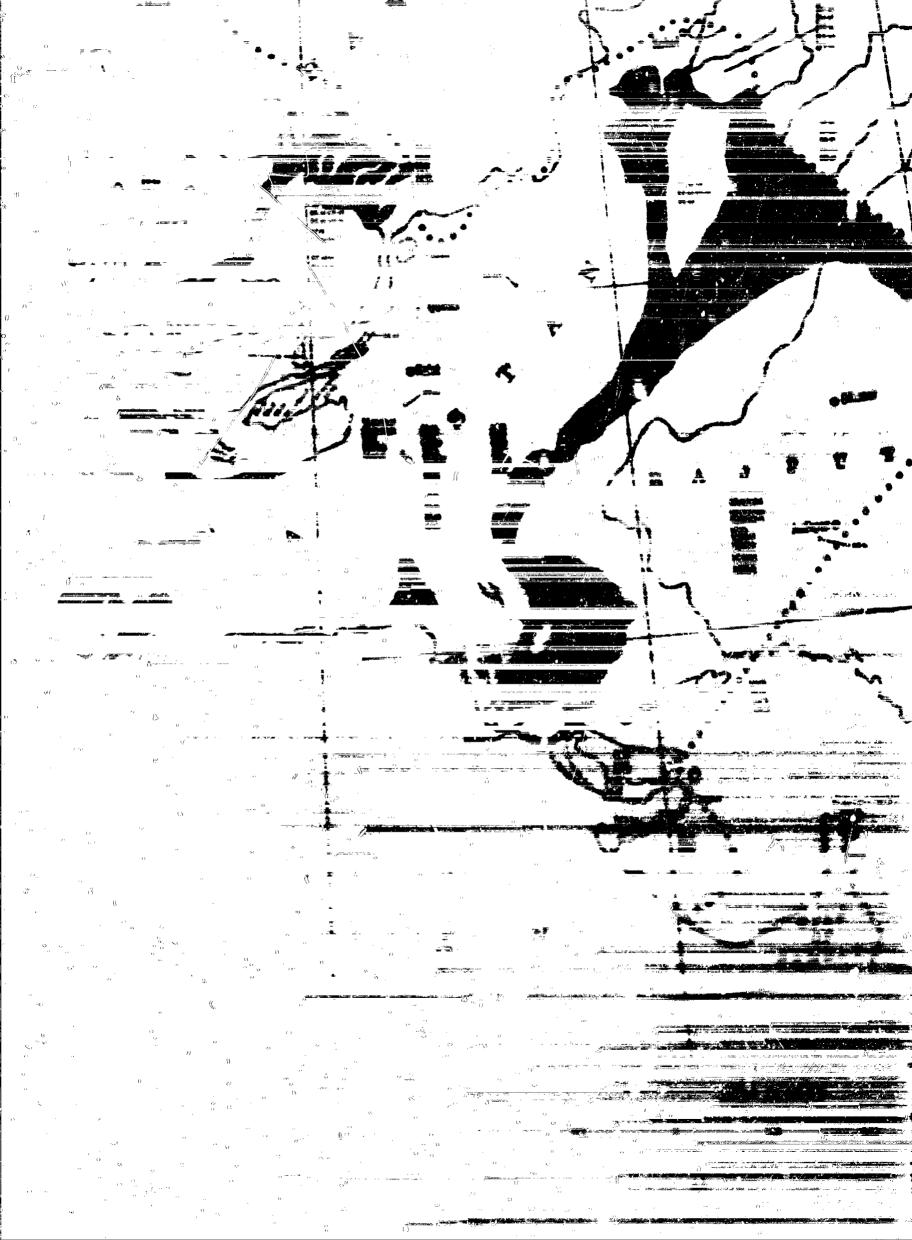
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YUMA TEST STATION







ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT LANDFORMS - SURFACE CONDITIONS

DESCRIPTIONS AND PHOTOGRAPHS

PLATE 18



LANDFORMS - SURFAC

					
Photo No.	CLASSIFICATION AND DESCRIPTION		FYPICAL GEOM		
	I. DEPOSITIONAL	Diag Bustila	Slope Occurrence Units		
	ALLUVIAL	Plan-Profile Units	Number of alope greater than 50% per 10 miles		
١	Abandoned courses: Abandoned courses are lengthy segments of a river abandoned when the stream chooses is new course across the floodplain.	*NA NA	NA NA	106 200	
2	Alluvial aprons: Alluvial aprons are created through coalescence of alluvial fans along the base of mountains or liateau escarpments. Several fans coalesce to form in alluvial apron.	1L, 7 1, 1L, 7	/ — To 0		
3	Alluvial fans. Alluvial fans are cons-shaped features occurring at the base of mountains, hills, escarpments, etc., where streams experience a sufficient reduction in gradient to deposit their loads. These fans, steepest near the mountains, slope gently outward with a continually decreasing gradient and are characterized by braided stream channels which scour their surfaces.	1L 1,1L 1,1L			
•	Boulder-choked wadies: Boulder-choked wadies are rejatively narrow and deep, intermittent streambeds, generally in mountainous or plateau regions, where boulders have been amassed in numbers sufficient to retard or prevent vehicular movement.	NA NA	NA NA		
5	Braided stream topography: Braided streams are shallow anastomosing channels, usually carrying heavy loads and/or flowing at moderate gradients. Topography formed by such atteams usually consists of irregular bars separated by shallow active or abandoned channels.	7	Lacking Lacking		
٠	Deltas are alluvial tracts of land, usually triangular in shape, formed at the mouth of a river. Inland boundaries of deitas often, but not invariably, coincide with the farthest upstream distributaries of a river.	7	Lacking Lacking		
7	Floodplains: Floodplains are relatively smooth, fiat lands bordering a stream. They are built of sediments deposited by the stream and inundated by floodwaters.	7 7, 1 7, 1, 1 L	Lacking To 0		
	River terraces: River terraces are flat strips of land border- ing river floodplains. They are charac erized by a sharp descent toward the river and by n cre elevated land on the opposite side. A steplike as rangement of several terraces often flanks larger floodplains.	7 7, 1 7, 1	- To 0		
,	Intermittent fresh-water lakes: Intermittent fresh-water lakes are standing bodies of inland fresh water which become dry during certain periods of the year.	NA NA	NA NA		
10	Intermontane plains: Basins of interior drainage between mountain ranges composed of fine-grained alluvium deposited by streams issuing from the adjacent mountains.	7, 1 7, 1, 1L	- To 0 To 0		
11	Marsh: Marsh is a tract of low (in reference to surrounding terrain), wet ground, usually miry and covered with rank grass and sedge vegetation and confined to fresh-water areas.		enon is classed as a surface condition and mappe ically featureless.	This is the state of the section of	
12	Natural levees: Natural levees are long, relatively narrow alluvial ridges, higher near the river and gradually aloping away from it, which are built up on either side of a stream by overbank flow. Surface drainage patterns range from minute drainageways to major crevasses, commonly found at right angles to the direction of levee elongation.	NA NA	NA NA		
13	Salt lakes: Salt lakes repermanent or intermittent bodies of saline water, penerolly of considerable size. Surface evaporation of water exceeds inflow, thus creating saline conditions.	NA	NA NA		
	COLLUVIAL				
14	Mud flow topography: Mud flow topography is formed by jumbled colluvial debris which slides down steep mountain sides during infrequent rains. This phenomenon occurs chiefly on steep slopes of loose shale, ash, and residual clay.	7 7, 4, 1	NA I		
15	Talus. Talus is an unconsolidated, sloping heap of fairly large rock fragments or debris formed at the base of an estarpment or steep slope through gravitational accumulation.	NA NA	· · ·		
	EOLIAN				
	Accumulations near parriers			† † † † † † † † † † † † † † † † † † †	

FACE CONDITIONS: DESCRIPTIONS AND PH YPICAL GEOMETRY FACTOR RANGES World-wide Range Range in South Central Asian Disert Relief Units Slope Unite Dogress Feet now beavily regetated mea der of an abandoned course in the 1 ... left quarter of the photograph 0 to 5 0 to 5 0 to 15 0 to 5 0 to 15 To 0 🚾 o 0 🚾



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... An ariny is a pron forming a narrow continuous band between the background mountains and the basis in the lower half of the photograph.



5. A vertical photograph of an alluvial far



4. Boulder-choked wad



monnel river



6. Present distributary system of the Mississippi River Delta



7. Floodplain of the Colorado River, looking southward from Laguna Dam, Arizona



8. A series of river terraces within a mountainous region



ziter lakes



10. Intermontane plain as viewed from advacent mountains



ll. Marsh



12. Cultivation on catural levees



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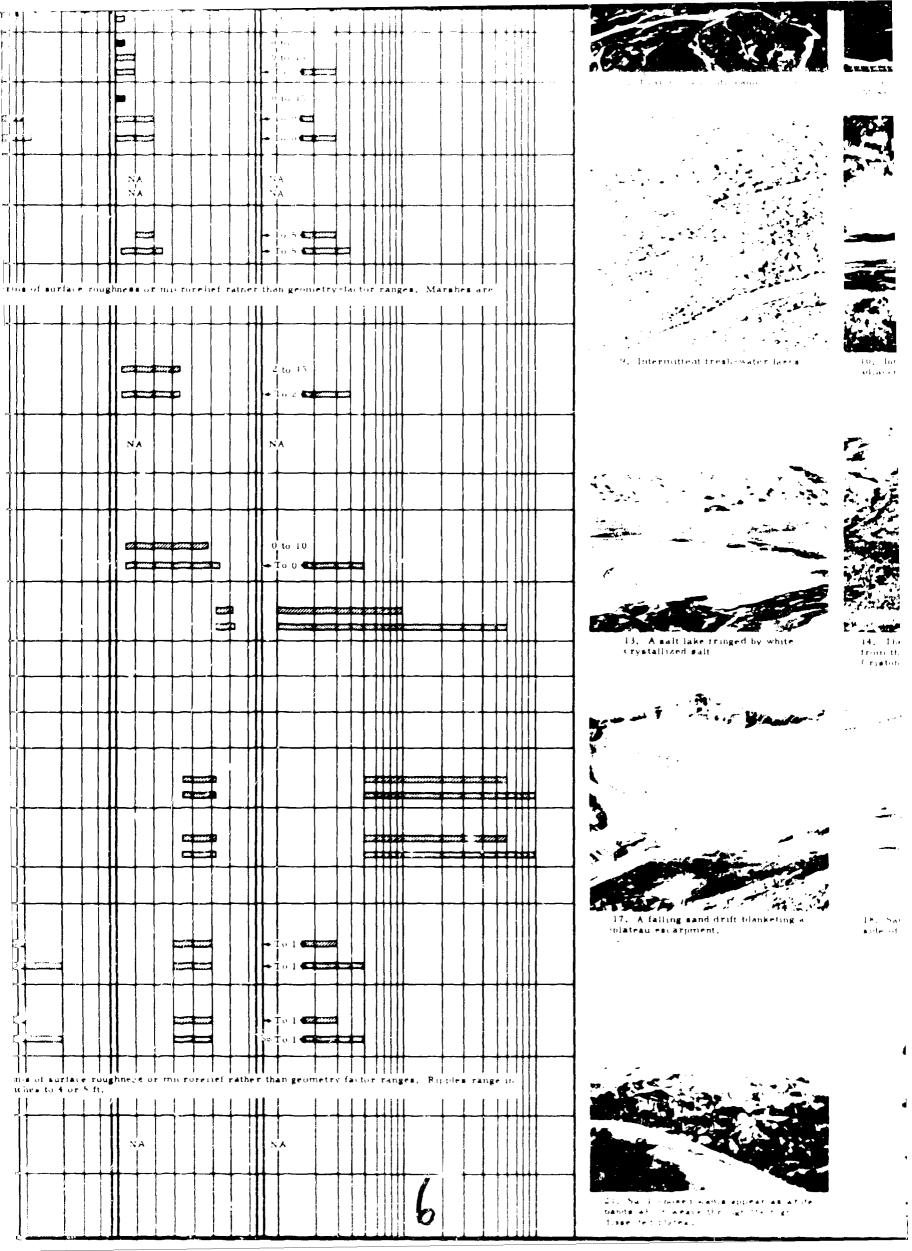


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It. A large combing sand drift one paching on a mountain front

	ries of deltas often, but not mover, and, contained eight the farthest upstream distributaries is a river,	7	l a l	n _x					-	· ·		- 10 ,
7	Floodplains Floodplains are relatively amouth, flat lands bordering a stream. They are built of sediments deposited by the stream and mundated by floodwaters.	7 7, 1 7, 1, 11	lac + lo 0 + lo 0									-
•	River terraces: River terraces are flat atrips of land bordering river floodplains. Frey are indirected by a sharp desicent toward the original by more elevated land on the opposite side. A. Sephike arrangement of several terraces often flanks larger floodplains.	7 7, 1 7, 1	Lack 	hing.							***	;
9	Intermittent fresh-water lakes: Intermittent fresh-water lakes are standing bodies of inland fresh water which become dry during certain periods of the year,	NA NA	NA NA									
lo	Intermontane plains: Basing of interior drainage between mountain ranges composed of fine-grained alluvium deposited by streams issuing from the adjacent mountains.	7, 1 7, 1, 1L	To 0 € To 0 €									
11	Marsh: Marsh is a tract of low (in reference to surrounding terrain), wet ground, usually miry and covered with rail grass and sedge vegetation and confined to fre n-water areas.	This phenom			a surfa		idition a	ind maj	oped			of se
12	Natural levces: Natural levces are long, relatively narrow alluvial ridges, higher near the river and gradually sloping away from it, which are built up on either side of a stream by overbank flow. Surface drainage patterns range from minute drainageways to major crewasses, commonly found at right angles to the direction of lever elongation.	NA NA	NA NA									
13	Salt lakes: Salt lakes are permanent or intermittent bodies of saline water, generally of considerable size. Surface evaporation of water exceeds inflow, thus creating saline conditions.	NA	AN									
	COLLUVIAL											
14	Mud flow topography: Mud flow topography is formed by jumbled colluvial debris which slides down steep mountain sides during infrequent rains. This phenomenon occurs chiefly on steep slopes of loose shale, ash, and residual clay.	7 1, 4, 1	NA NA									
15	Talus: Talus is an unconsolidated, sloping heap of fairly large rock fragments or debris formed at the base of an escarpment or steep slope through gravitational accumulation.	NA NA	NA NA									
	EOLIAN											
	Accumulations near barriers											
e distance and the second	Large extensive obstacles										\prod	
16	Climbing sand drifts: These are massive accumulations of wind-blown sand which form to the windward of extensive obstacles such as plateau scarps, hills, and mountains.	7 7	Lack Lack	- 1								
17	Falling sand drifts: Falling sand drifts are massive accumulations of wind-blown sand which form to the leeward of extensive obstacles such as plateau scarps, hills, and mountains.	7 7	Lack Lack	[
	Small isolated obstacles											
10	Sand dams: Sand dams are crescent-shaped mounds or ridges of wind-blown sand which form near the windward side of relatively small obstacles. The horns of the crescent extend downwind, often flanking the obstacle, and exhibit steep inward-facing slopes.	5, 6 5, 6		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	### ##################################	93. 7. 7. 9			••••• •••	* * *	225	
2.9	Sand shadows: Sand shadows are elongate triangular mounds of wind-blown sand which form to the leeward of relatively small obstacles. Sand dams are usually found to the windward of these obstacles.	5, 6 5, 6		mayann.	······ •••					† † † * * * * * * * *	### ###	
50	Rippled surfaces: Washboardlike surfaces caused by the heap- ing up of sand by wind action. They are normally found on the gentler slopes of dunes or in flat, sandy areas.	This phenome height from										
21	Sand-choked wadis Sand-choked wadis and intermittent stream beds generally within plain or pieteau areas which have been almost completely or partially filled with wind-blown sand.	NA.	NA.							† † †		
	* Not applicable.											













12. Cultivation on natural levees



14. The Siumgullion Mud Flow as seen from the lower end of Lake San Cristobal in Colorado



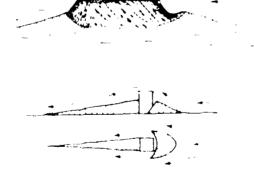
15. Steeply sloping talus cone flanking a plateau escarpment



16. A large climbing sand drift encroachin on a mountain front



18. Sand dam formed to the windward side of a typical mesa or butte



19. Sand shadow formed to the leeward side of a typical mesa or butte



20. Rippled surfaces



ANALOGS OF YUMA TERRAIN IN THE

SOUTH CENTRAL ASIAN DESERT

LANDFORMS - SURFACE CONDITIONS

DESCRIPTIONS AND PHOTOGRAPHS



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ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT LANDFORMS - SURFACE CONDITIONS DESCRIPTIONS AND PHOTOGRAPHS

PLATE ISA

Photo No.	CLASSIFICATION AND DESCRIPTION		Range at Yours	I Y PIC AL
	I, DEPOSITIONAL (CONT.) EOLIAN	Pranch rof le Units	Single Occurrence 1	4
	Sand dunes: Mobile heaps of wind lown sand independent of fixed objects or underlying topography,			
22	Barchans: Barchans are dunes having a crescentric ground plan with the convex side facing the wind and horns extending leeward. The profile is asymmetric with the gentler slope on the convex side and the steeper slope on the concave or leeward face.	4 4, 5, 6 4, 5, 6**		
23	Complex dunes: Complex dunes are irregular masses of sand not readily classifiable into types.	4, 4L 4, 41, 5, 5L, 5L/, 6L, 6L/*		
24	Peak and (21): These occur where the tips or horns of a cast-moving barchan join or intersect the windward side of another barchan, thus forming a circular or horseshoe-shaped hollow known as a fulji. The crest of the barchan slip-face which flanks the fulji is referred to as the peak.	4 4 4 7 7 1		
25	Transverse dunes: Transverse dunes are strongly asymmetric ridges extending transverse to the direction of dominant sand-moving winds. The leeward slope is steep; the windward, comparatively gentle,	4L# 5L#, 6L 4L, 4L#, 5L, 5L#, 6L, 6L#		
26	Longitudinal dunes: Longitudinal dunes usually consist of a single continuous ridge which swells and rises at regular intervals to form a chain of summits connected by a continuous wavy crest. The profile is asymmetric with one side exhibiting a moderate slope; the other, a sleep or slip face. Longitudinal dunes are aligned parallel to dominant sand-moving winds.	5L#, 6L# 5L, 5L#, 6L, 6L#**		
27	Stabilized free or active form: Active dune types which have been stabilized by vegetation but which still retain their initial form.	6 4,4L,4L/,5,5L 5L//,6,6L,6L//*		
28	Upsiloidal dunes: Upsiloidal dunes are U- or V-shaped dunes which are concave toward the wind. They are usually found in vegetated areas and are typically associated with a vegetation-free windward depression or "blowout" which provides a sand source for the dune.	5, 6 4, 5, 6	Lacking Lacking	
	LACUSTRINE			
29	Lacustrine terraces: Terraces which mark the shorelines of ancient lakes, or earlier high-water stages of existing lakes. They have nearly horizontal surfaces with relatively steep slopes facing the central portion of the lake.	7 7, 1	5-9/100 mi To 0	
	MARINE			
30	Beaches: Beaches are gently sloping strips of land bordering the sea, usually recognized as that part which lies between high-and low-water marks and formed by the action of the sea.	7 7	Lacking /-acking	
31	Mangrove swamp: Salt or brackish swamps along the coast where there are abundant mangrove trees.	7	Lacking Lacking	
32	Quicksand: Sand which is or becomes shifting, easily movable, or semiliquid upon the access of water. Found extensively in coastal areas of 5, C. A.		enon is classed as a surface condition and mag eatureless surfaces.	
33	Tidal mud flats: Marshy or muddy lands covered and uncovered by the rise and fall of the tide.	7 7	Lacking Lacking	
	ORGANIC-CHEFICAL			
34	Caliche: Cali. he is a calcareous deposit occurring at or near the surface which has accumulated from charged ground water moving upward and evaporating.	most desert	enon is classed as a surface condition and ma areas within plains of gentle slope. It may uc to several inches.	
35	Salt-encrusted surfaces: Surfaces characterized by thin encrustations of sail. They are common near coasts and in many alluvial plains areas.	This phenonic of these surf	eion is classed as a surface condition and ma	pped in terms of suletry of the encrust
36	Sait marsh: Sait marsher are list, poorly drained parts of a coastal region whose surfices are so near the level of the mean high tide that they are covered by the majourity of high tides.	7 7	Lacking Lacking	
	Playse. Playse are nearly flat areas of salt or salty fine- grained soils occupying hasins where water collects			

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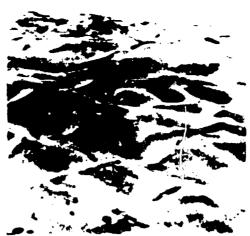
TAGE CONDITIONS: DESCRIPTIONS AND PH LYPICAL GEOMETRY FACTOR RANGES World-wide Range Range in South Central Asian Desert Reisef Unite Relief Type I 8 16 32 64 10 400 200 1000 22. A field of barchan dunes north of Magdalena Bay, Mexico The sinuous crest line of a longitudinal dune 0 to 5 ψ to 5 0 to 10 0 to 2 The light-colored caliche is overlain by

THOTOGIATIO **1111**





23. A vertical photograph of a complex dune field in Algeria



24. Peak and fulji topography in the Yuma Sand Hills, Arisona



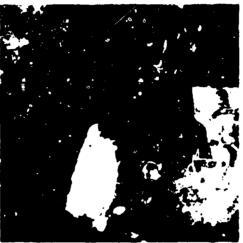
25. Transverse dunes Delta, Utah



line of a



27, Stabilized sand dune area



28. A upsiloidal dune developed along the northern edge of a blowout



29. Several flat-topped, steep-fronted lacustrine terraces flanking a mountain range in Utah



Eded by the his the sea



31. Mangrova swamp



32, Quickeand - NPA



33. Close-up of a tidal mud flat at low tide





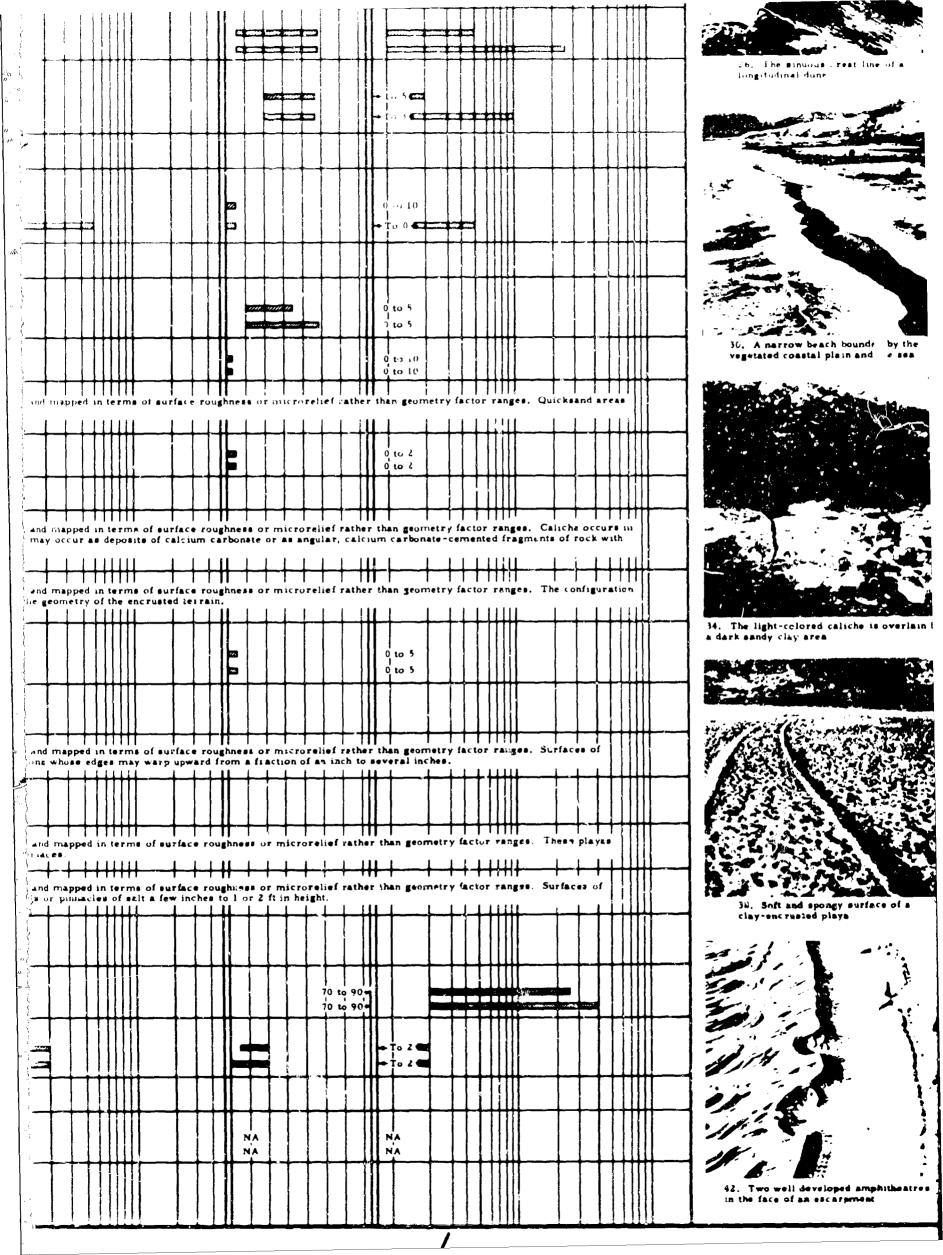


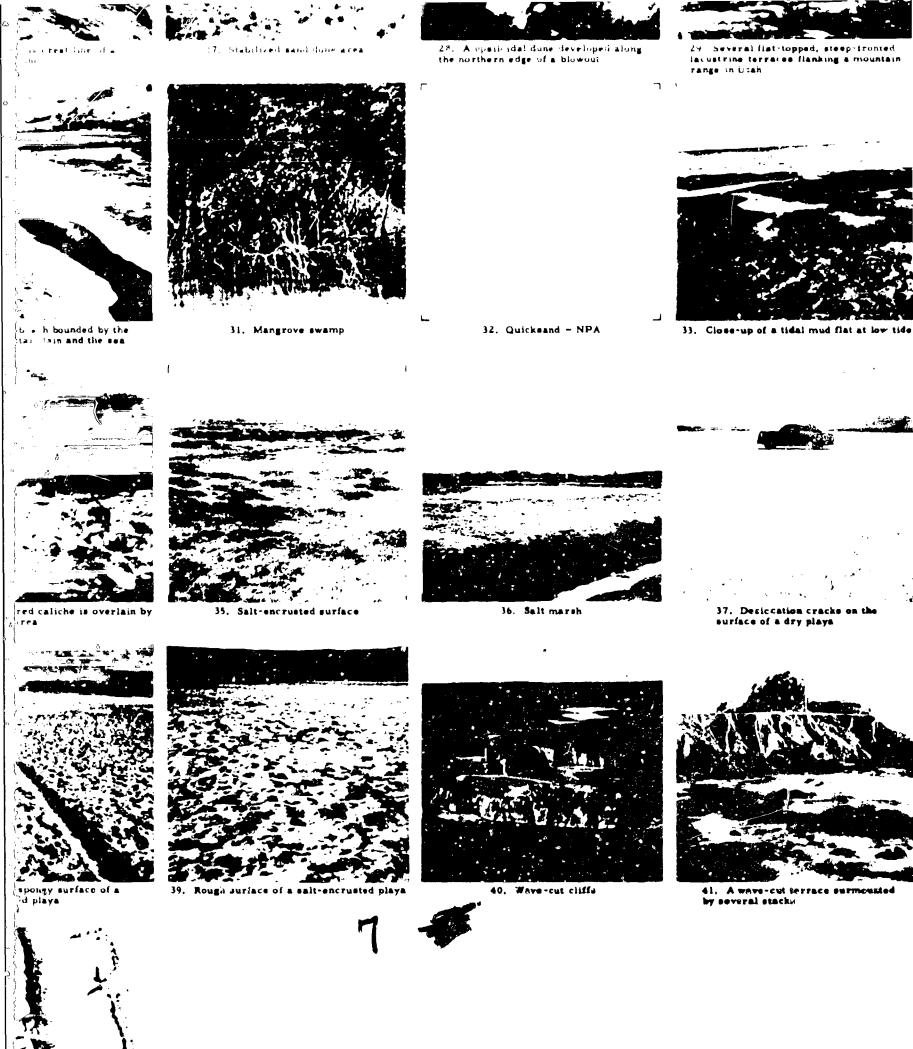
36 Sait marsh





	retain their initial form,	4, 41, 41 % 5, 51 51 , 6, 61, 61, 5	Last 100g
2.8	Upsiloidal dunes: Upsiloidal dunes are U or Visimped dunes which are concave toward the wind. They are usually found in vegetated areas and are typically associated with a vegetation-free windward depression or "blowout" which provides a sand source for the dune.	5, 6 4, 5, 6	I at hing I at hing
	LACUSTRINE		
29	Lacustrine terraces: Terraces which mark the shorelines of succent lakes, or earlier high-water stages of existing lakes. They have nearly horizontal surfaces with relatively steep slopes facing the central portion of the lake.	7 7, 1	5-9/100 mi
	MARINE		
30	Beaches: Beaches are gently sloping at ips of land bordering the sea, usually recognized as that part which lies between high- and low-water marks and formed by the action of the sea.	7 7	Lacking Lacking
31	Mangrove swamps: Salt or brackish swamps along the coast where there are abundant mangrove trees.	7 7	Lacking Lacking
32	Quicksand: Sand which is or becomes shifting, easily movable, or semiliquid upon the access of water. Found extensively in coastal areas of S. C. A.		enon is classed as a surface condition and mapped in terms of surface featureless surfaces.
33	Tidal mud flats: Marshy or muddy lands covered and uncovered by the rise and fall of the tide.	7 7	Lacking Lacking
	ORGANIC-CHEMICAL		
34	Caliche: Caliche is a calcareous deposit occurring at or near the surface which has accumulated from charged ground water moving upward and evaporating.	most desert a	nenon is classed as a surface condition and mapped in terms of surface areas within plains of gentle slope. It may occur as deposits of calciup to several inches.
35	Salt-encrusted surfaces: Surfaces characterized by thin encrustations of salt. They are common near coasts and in many alluvial plains areas.	of these surfa	enon is classed as a surface condition and mapped in terms of surface aces would be wholly dependent upon the geometry of the encrusted terms.
36	Salt marsh: Salt marshes are flat, poorly drained parts of a coastal region whose surfaces are so near the level of the mean high tide that they are covered by the majority of high tides.	7	Lacking Lacking
	Playas: Playas are nearly flat areas of salt or salty fine- grained soils occupying basins where water collects and evaporates after moderate or torrential rains.		
37	Dry: Dry playes are characterized by very hard, smooth, flat surfaces of fine-grained soil.		senon is classed as a surface condition and mapped in terms of surface are characterized by desiccated polygons whose edges may warp upwa
-	Moist: Moist playas are characterized by irregular, pully surfaces with a thin friable surface crust which is underlain by soft, spongy ground.		
38	Clay-encrusted. Clay-encrusted playas are moist playas with a surface crust of clay.		nenon is classed as a surface condition and mapped in terms of surface erized by slightly rolling and spongy surfaces.
39	Salt-encrusted: Salt-encrusted playes are moist playes with a surface crust of ealt.		nenon is classed as a surface condition and mapped in terms of surface are characterized by soft, puffy mounds or pinnacles of salt a few incl
D	II. EROSIONAL MARINE		
40	Wave-cut cliffs: Steep cliffs of bare rock, or occasionally un- indurated materials, resulting from wave erosion marking the seaward limit of the coast.	*NA NA	NA NA
î.	Wave-cut terraces: Steplike, narrow strips of land adjacent to or near the sea, which have been sculptured by the waves and current. Each terrace records a landward advance of littoral erosion.	7, 1 7, 1	- To 0
-	SURFACE WATER		
;2 =	Amphitheatres: Amphitheatres are semicircular erosion bays, formed at the head of drainage, which often scallop plateau scarps in arid regions.	NA NA	NA NA
	 Not applicable, indicates plan-profile designations are both gross and restrictive, 		
1	<u> </u>		





i escarpment

ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT LANDFORMS - SURFACE CONDITIONS DESCRIPTIONS AND PHOTOGRAPHS

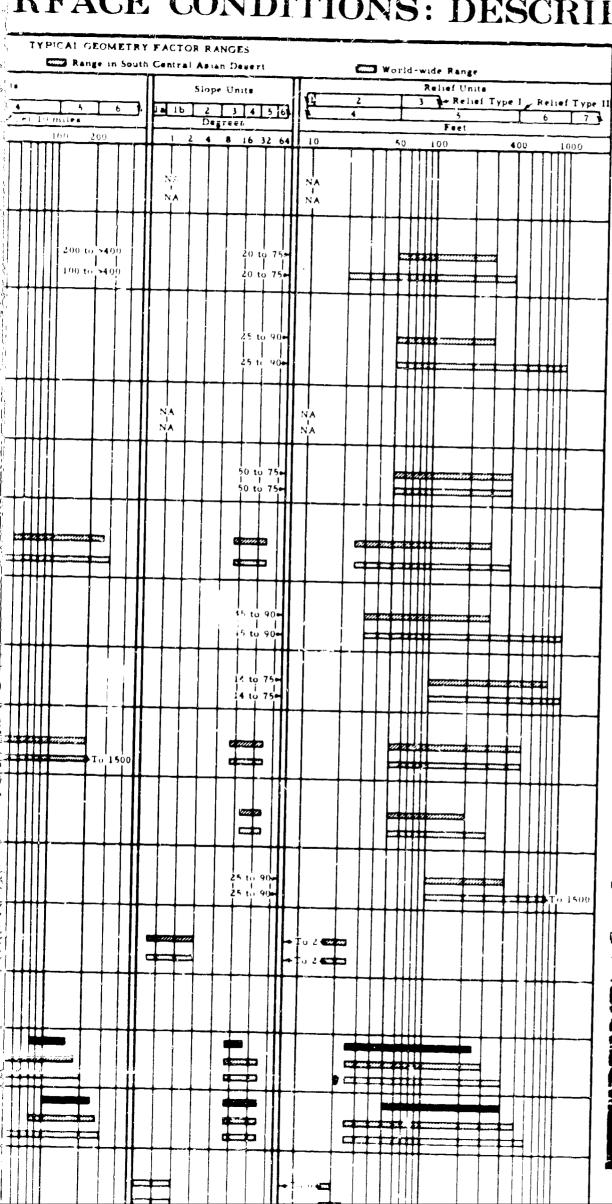
PLATE 18B



LANDFORMS - SURFA

Photo No.	CLASSIFICATION AND DESCRIPTION			Range at i	uma					ΊY		Al or
	H. FROSIONAL (CONT.)				51	ope i	Occurr	ence	t'nit#			
	II. EROSIONAL (CONT.)	Plan-Profile		2			3					,
	SURFACE WATER			Number o	5		reater	20		• • •	11) i
	Aqabas - Aqabas are gaps in asymmetrical ridges which connect											
43	basins of different elevations that occur between the ridges.	*NA	NA									
		NA	NA .		Ш	Ш	ļ			Ш	Ш	
	Badlands: Regions nearly devoid of vegetation where erosion,											
44	instead of carving hills and valleys of the ordinary type, has cut the land into an intricate make of narrow	•	j									300 1
	ravines, sharp crests, and pinnacles,											190 + -
į –		#		-++	††	+#	<u> </u>	+	+	 	$\dagger \dagger$	
	Buttes and mesas: Isolated residual prominences with very steep or precipitous slopes left as erosional rem-										$\ \cdot\ $	
45	nants of a plateau area. Mesas have distinctively flat tops; buttes have been so eroded that only small flat			anavana vinip va			1					
	tops or peaks remain,	2, 3, 5, 6				-	5					
		#	 		++	+#	 	+		†††	#	
46	Dry waterfalls: Dry waterfalls are precipitous drops or scarps found in dry wad! beds.	NA NA	NA									
		NA NA	NA		$\downarrow\downarrow$	$\parallel \parallel$	<u> </u>	ֈ-		$\downarrow\downarrow\downarrow$	\coprod	
47	Flatirons: Triangular remnants of an eroded hogback ridge	,	Lack	ing								
•	often occurring in series on the flank of a mountain,	7	Lack	~						$\ \ \ $	\parallel	
		#			††	+#	-	+		†††	#	
4.6	Foothills: Foothills are lower subsidiary hills at the foot of mountains or higher hills. They form transitional									Ш	\coprod	
.,	somes between the highlands and the adjacent lower land.	4, 4L	}}		} }		1			П	\prod	
			₩		₩		<u> </u>			\prod	\prod	
	Hanging valleys: Hanging valleys occur where the valley floor						ļ		} }			
49	of a tributary wadi is higher than the floor of the trunk valley in the area of junction.	NA NA	NA NA									
			""		++	$+ \downarrow \downarrow$	ļ	+		╁╂╁	₩	
50	Hogbacks: Hogbacks are sharp-crested ridges produced by un-	SL/.6LD		ann ann a	2 226			İ			11	
	equal erosion in steeply inclined rock.	(SLZ, 6LZ)			+					111		
					\prod					\prod	\prod	
51	Inselbergs: Inselbergs are prominent steep-sided residual hills or mountains, isolated or in groups, which rise abruptly from surrounding lowland surfaces of erosion.	4, 5, 6						****	25512 37	+++	#	
	astured it entire serious serial of erector.	4, (5, 6)							+	*#	Ħ	
					\prod					Ш	\prod	
52	Knife-edged spurs: Shary-crested rock ridges forming inter- stream divides which extend outward from mountain masses.	(I)	→ To 0	imirini siini								
		(5L, 5L/, 6L, 6L,) → 100 ◆		\perp L		<u> </u>			Ш	\coprod	
	Outlieve: Isolated remnants of rock separated from the main									\prod		
53	mass to which they were formerly joined.	(1,6)		ariana,						$\ \ \ $		
-		H	 		++	+H	ļ	+-	++	╁╂┧	#	├
54	Pediments: Pediments are relatively smooth rock plains gently inclined away from hill or mountain masses. They are	1, 15					men.	2000				
"	sometimes partly covered by a thin veneer of alluvium.	1, 14				١٢						
		#	╟─┤	+-+	++	+#	 	+-	-	╁╁╅	#	
	Random hills: Randomly oriented masses rising Indo than 1933 ft above the level of the surrounding country.											
				-	\coprod	Щ				Щ	\coprod	
	Unconsolidated random hills: Consist of unconsolidated	1 4									+	
35	material such as clay, sait, sand, or gravel,	4, 4L								ш		
		1	┢ ──┼	-++	++	+++	 	+	1			
56	Consolidated random hills: Consist of masses of sedimentary, ignoous, or metamorphic ruck,	4, 4L									322	
		4, 41			\coprod	Ш				<u> </u>		
										\prod		
57	Rock terraces. Rock terraces are relatively marrow benches left when a stream cuts a new vailey below the level of the eresional plain which is cut into the bedrock,	1, 7	4100		*	++		=				
	or and organization of the law the bedrock,	1, 7	→ Y = 0 (#	+		7				
					7- 7	7.77	,		,	A	-	

RFACE CONDITIONS: DESCRIPTIONS AND P





43. A motor road winding through an again



47. Flatirons

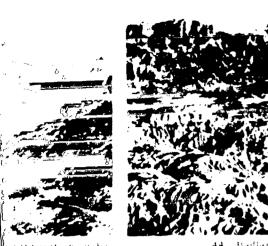


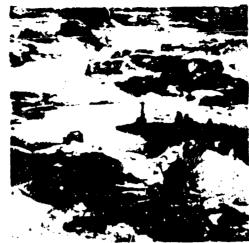
51. Inselbergs rising above the surrounding plain, east of Castle Dome Range, Arizona



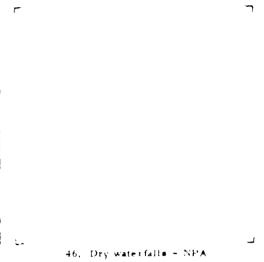
Sec. Propose of take the or near

AND PHOTOGRAPHS





45. Buttes and mesas





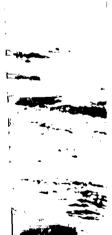
48. A band of foothills at the base of mountain range



49. Hanging valley



60, Hogbacks



the surrounding thinge, Arizona



52, Knife-edged spurs extending from a mountain range



53. Outliers



54. A gently sloping lediment flanking the Grand Atlas Mountains in southern Moroco

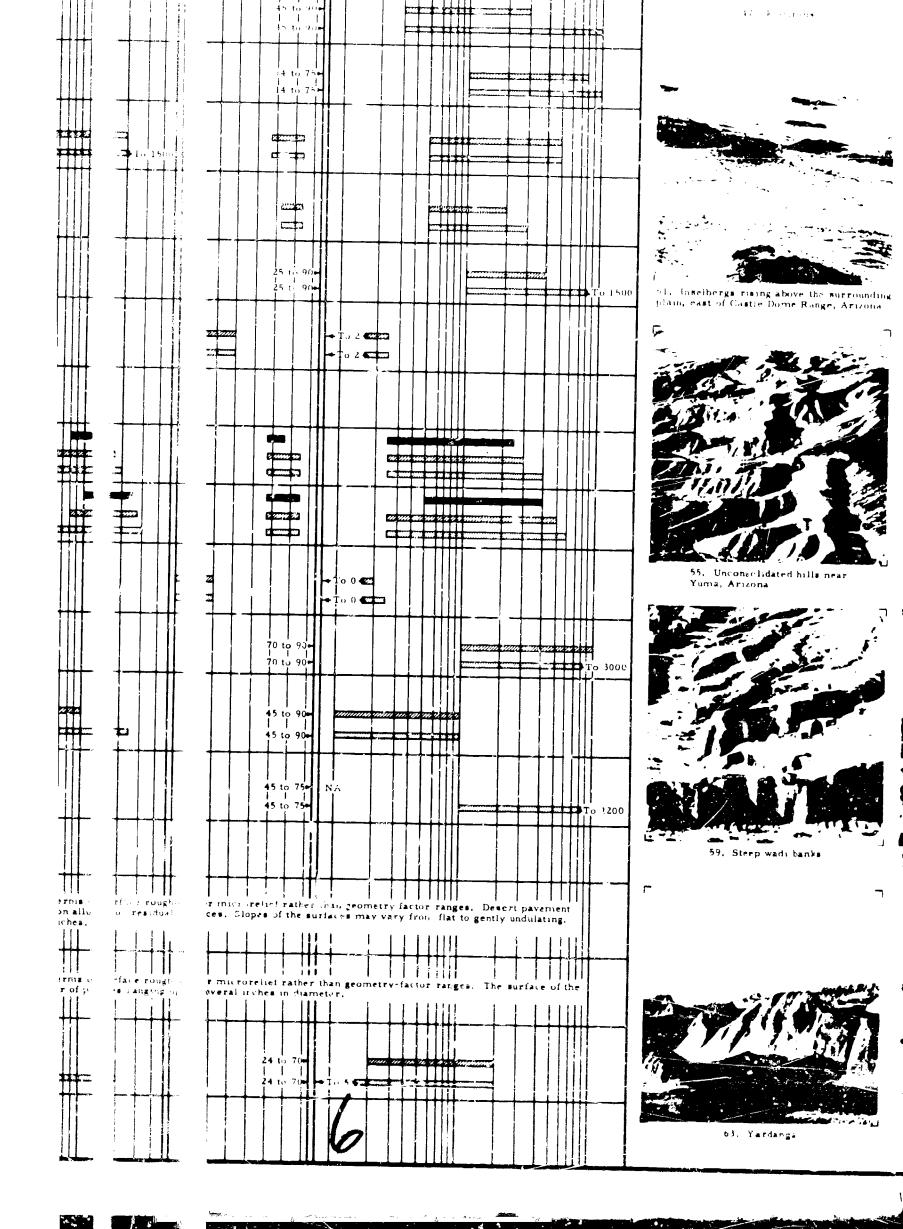






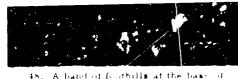


48	neartains or righer heas. The, time transitions. somes between the highlands and the adjacent lower land.	4, 4;								‡1‡1: ‡1‡1:		月 : :
49	Hanging valleys: Hanging valleys occur where the valley floor of a tributary wadi is higher than the floor of the trunk walley in the area of junction.	NA NA	NA NA									:
50	Hogbacks: Hogbacks are sharp-crested ridges produced by un- oqual erosion in steaply inclined rock,	(51 , 61) (51 , 61)										
51	Inselbergs: Instibergs are prominent steep-sided residual hills or mountains, isclated or in groups, which rise abruptly from surrounding lowland surfaces of erosion.	4, (5, 1)								*		•
52	Kniferedged spurs: Sharp-crested rock ridges forming inter- stream divides which extend outward from mountain masses.	61. (51, 51/, 61., 61/	→ To 0 (1
7 53	Outliers: isolated remnants of rock separated from the main mass to which they were formerly joined.	6		5								•
54	Pediments: Pediments are relatively smooth rock plains gently inclined away from hill or mountain masses. They are sometimes partly covered by a thin veneer of alluvium,	1, 1L 1, 1L				2 0						1
	Random hills: Randomly oriented masses rising less than 1000 ft above the level of the surrounding country.											
55	Unconsolidated random hills: Consist of unconsolidated material such as clay, silt, sand, or gravel.	4 4, 4L 4, 4L										
56	Consolidated random hills: Consist of masses of sedirientary, igneous, or metamorphic rock.	4 4, 4L 4, 4L										
57	Rock terraces: Rock terraces are relatively narrow benches left when a stream cuts a new valley below the level of the erosional plain which is cut into the bedrock.	1, 7 1, 7	→ To 0	"								
58	Scarps: Scarps are more or less continuous, precipitous alopes exhibiting more than 100 ft of relief.	NA NA	NA NA									
59	Steep wadi banks: Steep wadi banks are mapped where a con- spicuous number of wadies bordered by high precipi- tous banks occur. Wherever banks are higher than 100 ft they are considered scarps.	1, 1L, 1L/ 1, 1L, 1L/										5
60	Incised meanders. Incised meanders are deep, sinuous velleys cut by rejuvenated streams, the meandering course having been sequired in a former cycle.	NA NA	NA NA									
	WIND											
61	Descripevement: Descripevement is a mosaic of closely packed pebbles and broken rock fragments usually coates with a stain or crust of manganese or iron exide.	This phenome occurs as a t Gonstituent p	hin venee	r of clos	ely-fit	ted gra	avelor	rock ir.	Keneat	8 OT 4	المتحييك	
6.2	Hamadae: Hamadae are extensive, flat to undulating surfaces of bedrock or bedrock covered by a thin veneer of pebbles or rock fragments.	This phenome hamade is (la	mon is cl	assed as y undula	a suri	d may	ondition be cove	and ma red wit	pped ir	tern	or or sign tperbble	r I so e
•3	Yardangs: Yardangs are veregular ridges or mounds, commonly alternating with round-bettomed troughs, formed by wind erosion of sit and clay (often accient plays surfaces).	(51 7) (5 7 , 5 1 7 , 6 1 7										
	• Net applicable 1 (2.1) Circles plan-profile resignations indicate gross landscapes											





inverthe surrounding the Range, Arizona



48. A band of footbills at the base of mountain range



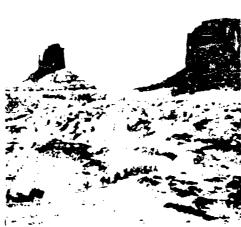
1). Hanging valley



50. Hoghacks



52. Knife-edged spurs extending from a mountain range



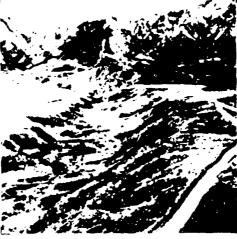


54. A gently sloping pediment flanking the Grand Atlas Mountains in southern Morocco





56. Rugged crystalline hills rising above a desert plain



57. Bedrock terraces, thinly veneered with gravel along a meandering stream



58, Scarps





60. The valley of the San Juan River, Utah, incised to a depth of 1200 ft into the plateau



61. A smooth surface of desert pavement, The tire tracks have menetrated the underlying milt





ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT

LANDFORMS - SURFACE CONDITIONS
DESCRIPTIONS AND PHOTOGRAPHS

PLATE 18C

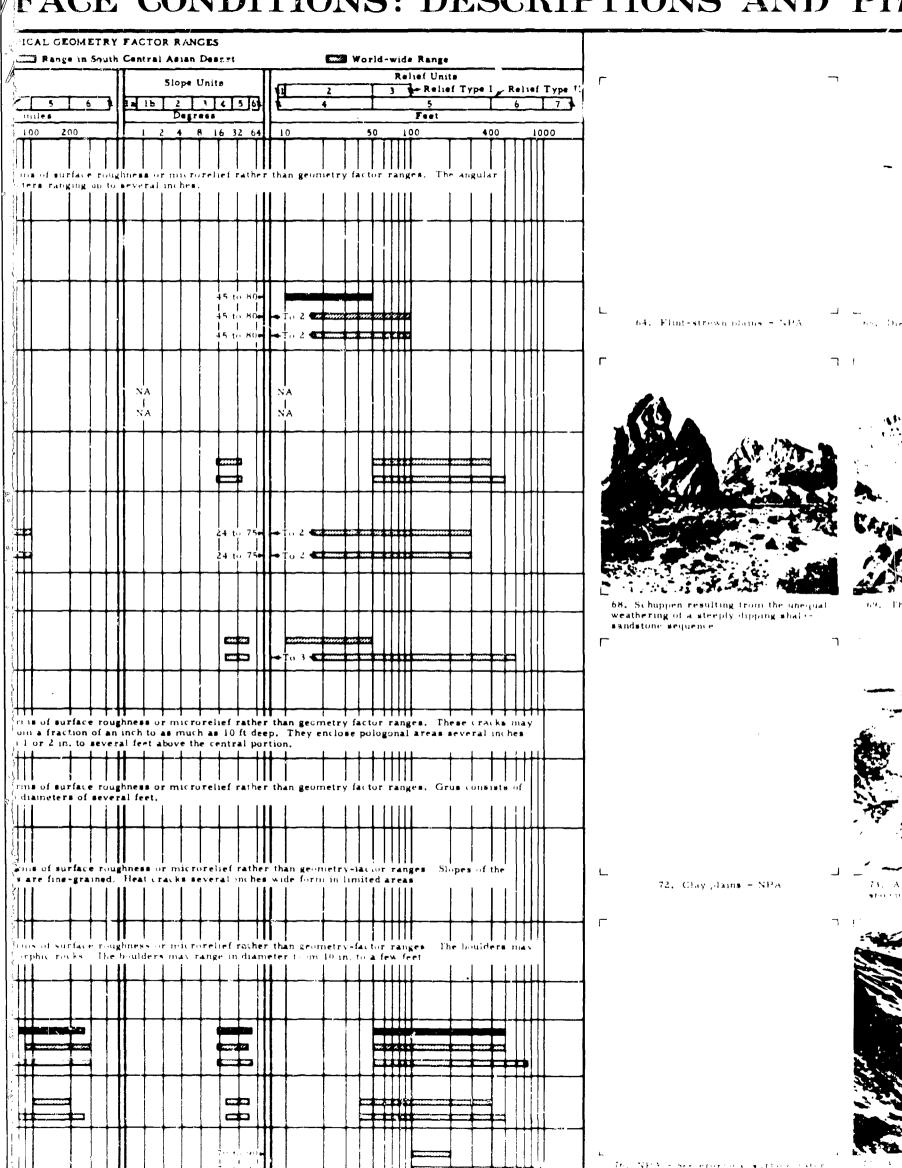
80523



LANDFORMS - SURFA

Phyto No.	CLASSIFICATION AND DESCRIPTION		Range at Yuma	TYPICAL G
			Slope Occus	rrence Units
	II. EROSIONAL (CONT.) WIND	Plan-Profile Units	Number of slopes greate	
	W110		Number of Hope greate	20 100 .
04	Fig. strewn plains. Fiint-strewn plains are flat to undulating surfaces developed on weathered ilmestone or chalk. They are characterized by scattered pebbles and sharp-edged chips of flint weathered from the parent		enon is classed as a surface condition dichips of flint which cover these plain	
	III. MISCELLANEOUS			
	INTRUSIVE			
65	Dikes: Wall-like intrusions of igneous rock which cut ocross the bedding or other layered structure of the country rock. On eroding they commonly form narrow sharp-crested ridges which run for miles across country.	41. (4L, 5L, 6L) (4L, 5L, 6L)		'
66	Salt domes: Masses of salt that reach the surface in domal up- lifts. The salt usually forms an irregular surface and may stand at higher or lower elevations than the surrounding-country rock. The salt may flow downhill and form spectacular salt-glaciers.	*NA NA	NA NA	
67	Knobs: Knobs are rounded, isolated hills or small mountains. They usually constitute the surface expression of weathered plutonic intrusions.	4. 6 4, 5, 6		
68	Schuppen: Tabular elongate manses of rock formed in areas with a vertically or near-vertically dipping shalessandstone sequence. The softer shales erode leaving the harder materials standing at considerable heights above the aurrounding terrain (after Harrison).	4. 4#		
	METEORIC			
69	Meteor craters: Steep-walled, saucer-shaped depressions produced by the impact and accompanying explosion of an object of extraterrestrial origin.	NA NA	NA NA	
	RESIDUAL			
70	Heat cracks: Irregular cracks which form in clayey soil by descication.	be from a fra	enon is classed as a surface condition action of an inch to several inches wide et across. The edges of the pologon w	e at the top and from a fra-
71	Grus: The accumulation of countless discrete particles on the surface of granite and sometimes extending to depth greater than 10 ft which have formed from weathering of the various minerals forming the rock.		enon is classed as a surface condition ments of weathered granite which may	
72	Clay plains: Clay plains are extensive, generally level to undulating regions of fine-grained soil, character tically featureless except for widly spaced isolated hills und rocky outcrops. Although these regions become seas of mud after infrequent rains, heat cracks are common after prolon; ed drought.		enon is classed as a surface condition at to gently undulating with only slight	
73	Exfoliated boulders: A erm applied to boulders whose surfaces have broken or peeled off as scales, lamellas, or concentric sheets.		enon is claused as a surface condition rounded fragments of igneous, sedim	
	TECTONIC			
74	Basin ranges: Ranges of hills or mountains formed by faulted and tilted blocks of strata (separated by basins).	4 4 . 4L.(5 <u>L,5L/,6L,</u>	51_2	
75	Elongate domes. Elongate domes are elliptical upfolds, the beds dipping away from centrally located accs.	- 4L 4, 4L		
76	Scarps: Scarps are more or less continuous, precipitous slopes exhibiting more than 100 ft of relief.	NA NA	NA NA	
1	Intramontane valleys: Intramontany valleys are narrow valleys			

FACE CONDITIONS: DESCRIPTIONS AND PHO





– - 65 – Dikes radiating from a volcanic neck



66. Diagram of Kuh-i-Namok sait dome and glacier in western Iran



67. A granite knob rising abruptly above a desert plain



(rom the anequal dipping shale-

- NPA



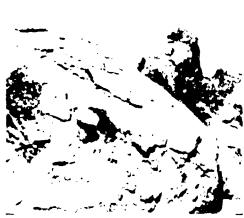
69. The famous Arizona meteor crater



70. Heat cracki



71. Grus deposit resulting from weathering of igneous rock



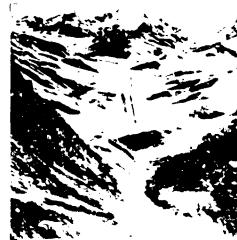
73. A close-up of an exfoliated boulder showing the typical spalling action



74. Basin ranges in the center and background of the photograph separated by alluvial aprons



75. A vertical photograph of a breached elongate dome with inner dendritic drainage



77. A dictor read following tree drong or



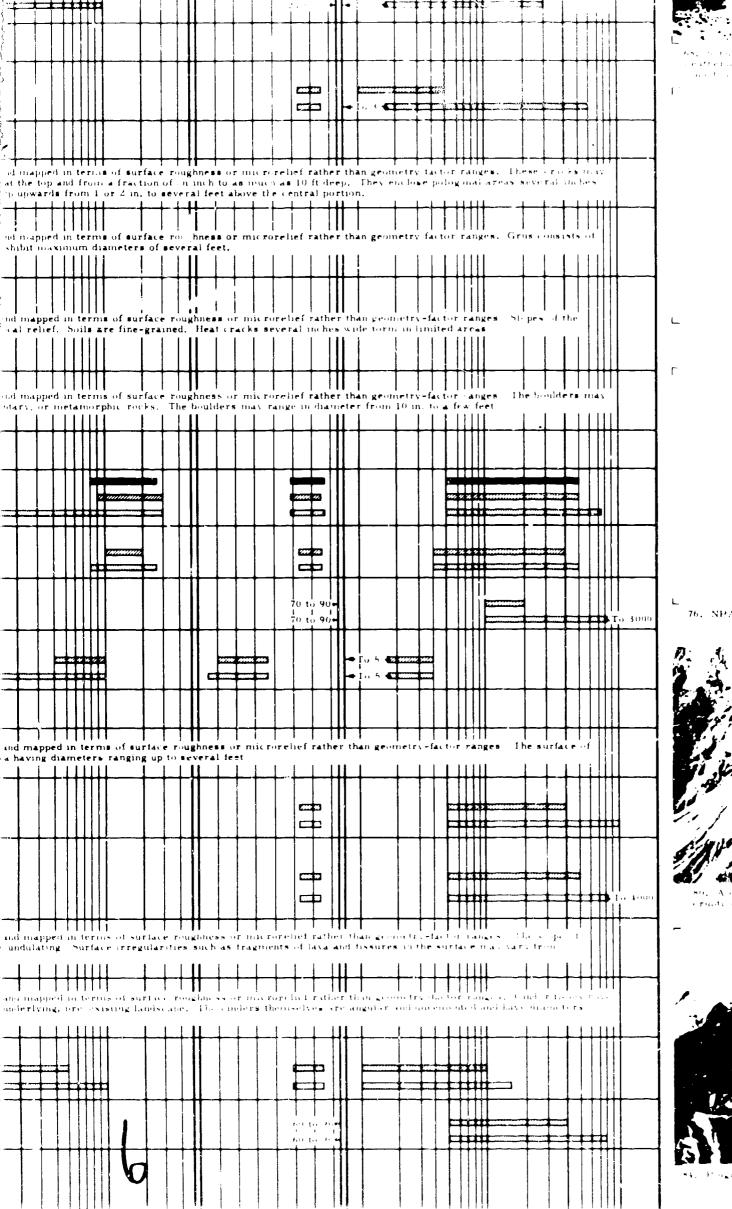
75. A brosen axa flow partiall, burger



74 Cinder cone

′ -	sance one se dence. The softer shales erode leaving the rarder materials standing at considerable heights above the surrounding terrain (after Harrison).	4. 4//
	METEORIC	
69	Meteor craters: Steep-walled, saucer-shaped depressions produced by the impact and accompanying explosion of an object of extraterrestrial origin.	NA NA NA
	R. SIDUAL	
70	Heat cracks: Irregular cracks which form in clayey soil by dessicatio	This phenomenon is classed as a surface condition and mapped in terms of a be from a fraction of an inch to several inches wide at the top and from a fraction several feet across. The edges of the pologon warp upwards from 1 or 2:
71	Grus: The accumulation of countless discrete particles on the surface of granite and sometimes extending to depths greater than 10 ft which have formed from weathering of the various minerals forming the rock.	This phenomenon is classed as a surface condition and mapped in terms of a angular fragments of weathered granite which may exhibit maximum diamete
72	Clay plains: Clay plains are extensive, generally level to undulating regions of fine-grained soil, characteristically featureless except for widely spaced isolated hills and rocky outcrops. Although these regions become seas of mud after infrequent rains, heat cracks are common after prolonged drought.	This phenomenon is classed as a surface condition and mapped in terms of suplains are flat to gently undulating with only slight local relief. Soils are fine
71	Exfoliated boulders: A term applied to boulders whose sur- faces have broken or peeled off as scales, lamellae, or concentric sheets.	This phenomenon is classed as a surface condition and mapped in terms of sube angular or rounded fragments of igneous, sedimentary, or metamorphic rounded.
	TECTONIC	
74	Basin ranges: Ranges of hills or mountains formed by faulted and tilted blocks of strate (separated by basins). 4,	L. (5L, 5L/, 61, 61.7)
75	Elongate domes: Elongate domes are elliptical upfolds, the beds dipping away from centrally located axes.	4, 4L 4, 4L
76	Scarps: Scarps are more or less continuous, precipitous slopes exhibiting more than 100 ft of relief.	NA NA NA NA
77	Intramontane vaileys: Intramontane valleys are narrow valleys or troughs with exterior drainage lying between mountains.	., 1L 1, 1L
	VOLCANIC	
78	Broken lava flows: Flat to undulating lava areas characterized by sharp-edged rocks and boulders.	This phenomenon is classed as a surface condition and mapped in terms of so the flow is composed of large, angular blocks of lava having diameters rangi
79	Cinder cones: Cinder cones are conical hills formed by the accumulation of volcanic ash or clinkerlike material around a vent.	(6, 6Z) (4, 4/, 5, 5/, 6, 6Z)
80	Craters and calderas: Bowl- or funnel-shaped depressions of volcanic origin which are more or less carcular in plan and rimmed by an infacing scarp. Craters are commonly less than a mile in diameter, while calderas have diameters several times larger.	NA NA NA
81	Lava flows: Lava flows are solidified stationary masses of igneous rock which issued from a volcanic cone or fissure.	This phenomenon is classed as a surface condition and mapped to term to the surface of these flows varies from flat to gently indulating. Sinface the deveral inches to 10 ft.
72	Cinder fields: Cinder fields are flat to undulating areas, often miles in extent, composed of volcanic ejecta that has mantled the pre-existing landscape.	This phenomenon is claused as a surface condition and mapped in Green et a slopes which are determined to some extent by the orderlying cross coston ranging between 4 and 34 mm.
41	Mud voicances Small cone-shaped mounds built of clay and ordinarily formed by the eruption of sulfurous and bituminous mud from a central vent or orifice.	(4. 4 y/, 5. 5 y/, 6, 6 y)
74	Necks and plugs. Necks and plugs are lava-filled conduits of an extinct volcano exposed by erosion.	
	† ()Circled plan-; rof le designations indicate gross landscap- * Not applicable.	

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Head to the second of the seco

72. Clay plants - WPA

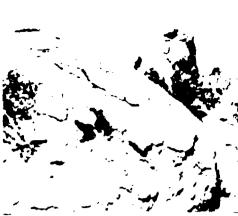
76. NPA - See erognonal gorthce wat



. See, A coded the real, the form the let, an extraction x and of the x and



94. Progeto o Σ ⊈ வசுக்க வி.க.



73. A close-up of an exformated boulder.

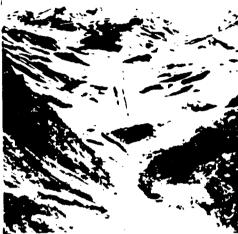


The Profit of the Fo

74. Basin ranges in the center and background of the photograph separated by aphonia aprons



75. A vertical photograph of a breached elongate dome with inner dendrition drainage



77. A motor road following the bottom of an intramentane valley



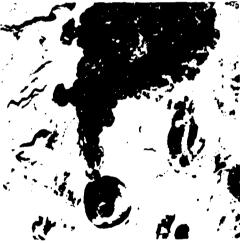
78. A broken lava flow partially buried by wind-blown sand



79. Cinder cone



, since come let, and



81. A vertical photograph showing a basaltic flow extended from a cinder cone



82. An undulating cinder field with spatter cones in the foreground



83. A group of mud volcances



Arthur School Steiner